

MEMOIRS
OF THE
CARNEGIE MUSEUM.

VOL. VII.

NO. 2.

THE FOSSIL TURTLES OF THE UINTA FORMATION.

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The finest and most complete assemblage of the remains of fossil turtles as yet secured from the Upper Eocene of the Uinta formation has been brought together in the Carnegie Museum through the activities of its various expeditions to Utah. By the kindness of Dr. William J. Holland, the Director of the Museum, I have been permitted to study this collection, and the present paper presents the results of my investigations.

The collection comprises more than fifty individuals, and was made by field-parties conducted by Messrs. Earl Douglass and O. A. Peterson and as an incidental part of their search of the Uinta exposures for the remains of extinct mammals. An important feature of this collection is the determination of the exact geological horizons in which the specimens were found, thus establishing a firm foundation for future correlative work.

The chelonian fauna of the Uinta formation is of peculiar interest, since it marks the last appearance of several forms which had their beginning, so far as our present records go, in the Upper Cretaceous and Lower Tertiary. Of the six genera recognized in the present collection from the Uinta formation only three, *Anosteira*, *Amyda*, and *Testudo*, are known to pass upward into the younger Tertiaries. *Anosteira* is known from the Lower Oligocene of England, *Amyda* reappears in the Miocene of the Atlantic coast, while *Testudo* is found in the overlying Oligocene. It appears that the Uinta thus marks an important stage in the history of the chelonian life of the Upper Eocene.

The Baënidæ make their last appearance. The Dermatemydidæ are rep-

resented for the first time by the single genus and species *Anosteira ornata* Leidy. The Emydidæ, suggestive of swampy conditions, in the number of species are the most abundant turtles in the present collection. Seven species have been recognized and larger collections will doubtless add several more to the list. The soft-shelled river-turtles, Trionychidæ, indicative of flowing water, are represented by at least three species, one of which is as large as the existing Asiatic species. The presence of true land-tortoises, Testudinidæ, is represented by three species of the genus *Hadrianus*, which includes tortoises some of which attain a length of more than three feet, and the genus *Testudo* by a single species, the first recorded occurrence, in North America, of this genus below the Oligocene. The discovery of the fossil remains of the lizard-like reptile *Glyptosaurus* in the Uinta according to Osborn¹ "hints as to the Floridan or south temperate conditions of climate."

There were a considerable number of specimens in the collection which were too fragmentary for specific determination, and in two instances at least I am inclined to the opinion, that, had better material been available, distinctive characters would have been found to show the presence of additional species new to the fauna.

I take this opportunity to protest most emphatically against the establishment of new species of turtles based upon inadequate specimens, for it certainly cannot serve any useful purpose to burden the literature with a lot of useless and meaningless names. The difficulties encountered in the present study, in recognizing to which species certain specimens belonged, when almost perfect individuals were at hand, shows the futility of naming scraps with which subsequently discovered material can never with absolute confidence be identified. There are perhaps some few exceptions, for occasionally a fragmentary specimen is found which shows a sculpture, or some character of such striking peculiarity, as to make it stand out distinctly from all previously described forms. The present study has demonstrated that a considerable variation within the limits of a species is to be expected, and, until the range of these variations is determined, it is quite useless to describe new forms based upon some small part of the carapace or plastron, which shows some slight difference from described forms, when the very next specimen discovered may have these same features and yet have other characters to be found in an adequate specimen, which show it to belong to a well-established species.

I wish also to protest against the practice of naming species simply because the specimen comes from a formation from which the genus to which it belongs has not previously been recognized. In other words it is assumed that 'it is not

¹ Osborn, H. F., "Age of Mammals," 1910, p. 160.

likely that a species known from a lower horizon continues over into a higher horizon,' therefore a hunt for characters to separate it from the other species of the genus is instituted, with the result that minor differences are magnified to represent specific differences, when, had the specimen come from a formation in which species of the genus were already known, it would in all probability have found a resting-place within one of the described species.

In order to facilitate comparisons of the descriptions here given with those of other described forms I have closely followed the order of arrangement used by Hay in his monographic study of the fossil turtles of North America.

At this point I wish to acknowledge the assistance rendered me while this paper was in the course of preparation. First of all I express my gratitude to Dr. W. J. Holland for his hearty coöperation at all times, for the privilege granted me of studying this fine collection of fossil turtles, and for his editorial oversight of the work. I am under obligations to Dr. W. D. Matthew, of the American Museum of Natural History, New York, for the loan of type-specimens, and to Dr. O. P. Hay, to whom, because of his wide knowledge of the turtles, I am especially indebted for invaluable advice upon numerous occasions. The text-figures were made by the well-known artist, Mr. Rudolph Weber, the photographs are by Mr. Arthur Coggeshall, of the Carnegie Museum.

GEOLOGICAL OCCURRENCE.

All of the specimens considered in the present paper are from the Uinta formation as exposed in the Uinta Basin at the southern base of the Uinta Mountains, and from that part of the basin which lies within Uinta County, Utah. The geological positions of the various specimens as here given were taken from the original field-labels which accompanied each specimen, so that these determinations are wholly the work of Messrs. Earl Douglass and O. A. Peterson, whose long experience in the field insures the accuracy of their observations.

In 1895 the Uinta formation was divided by Peterson² into three levels, or horizons, designated as follows, A (Lower), B (Middle), and C (Upper) Uinta.

The remains of turtles have now been found in all three horizons, though judging from the present collection, individuals occur most abundantly in Horizon B, but the number of species recognized in the collection is about evenly divided between Horizons B and C. Up to the present time only one species is known from Horizon A. Douglass³ has pointed out that "the lower portions of these deposits may be, and probably are, contemporaneous with portions of deposits in the

² Peterson, O. A., Bull. Amer. Mus. Nat. History, VII, 1895, p. 74.

³ Douglass, Earl, Bull. Geol. Soc. of America, vol. 25, 1914, p. 418.

Bridger and Washakie Basins and with other deposits elsewhere." If this be the true condition, it may to some extent account for the presence of many species common to the two formations.

Below is given a list of the identified species occurring in each of the three subdivisions of the Uinta formation.

HORIZON A (LOWER UINTA).

Baëna inflata sp. nov.

HORIZON B (MIDDLE UINTA).

<i>Baëna arenosa</i> Leidy,	<i>E. hollandi</i> sp. nov.,
<i>B. emiliæ</i> Hay,	<i>E. uintensis</i> Hay,
<i>B. inflata</i> sp. nov.,	<i>Hadrianus utahensis</i> sp. nov.,
<i>B. platyplastræ</i> sp. nov.,	<i>Testudo uintensis</i> sp. nov.,
<i>B. gigantea</i> sp. nov.,	<i>Amyda egregia</i> Hay,
<i>Echmatemys callopyge</i> Hay,	<i>A. scutumantiquum</i> (Cope).

HORIZON C (UPPER UINTA).

<i>Baëna emiliæ</i> Hay,	<i>Hadrianus corsoni</i> (Leidy),
<i>Echmatemys douglassi</i> sp. nov.,	<i>H. robustus</i> sp. nov.,
<i>E. depressa</i> sp. nov.,	<i>Anosteira ornata</i> Leidy,
<i>E. obscura</i> sp. nov.,	<i>Amyda</i> sp.,
<i>E. pusilla?</i> Hay,	<i>Glyptosaurus</i> sp. indet.

Six genera and twenty species are recognized in the present collection, whereas in 1908, at the time Doctor O. P. Hay published his "Fossil Turtles of North America" only four genera and five species were accredited to the Uinta formation. These were as follows:

<i>Baëna emiliæ</i> Hay,	<i>Hadrianus tumidus</i> Hay,
<i>Echmatemys callopyge</i> Hay,	<i>Amyda crassa</i> Hay.
<i>E. uintensis</i> Hay,	

The two latter species have not been recognized in the present collection, although each of the others is represented by from two to six individuals, so that altogether six genera and twenty-two species of fossil turtles have now been found in the Uinta formation. The known geological range of these species is graphically shown in the accompanying table.

GEOLOGICAL RANGE OF RECOGNIZED SPECIES.

Name.	Wasatch.	Bridger.				Uinta.			Oligocene.
		A	B	C	D	A	B	C	
Baënidæ:									
<i>Baëna arenosa</i> Leidy,	×		×		×		×		
<i>B. emiliæ</i> Hay,						×	×		
<i>B. inflata</i> sp. nov.,						×	×		
<i>B. platyplastra</i> sp. nov.,							×		
<i>B. gigantea</i> sp. nov.,							×		
Dermatemydæ:									
<i>Anosteira ornata</i> Leidy,		×	×	×				×	
Emydæ:									
<i>Echmatemys callopyge</i> Hay,							×		
<i>E. douglassi</i> sp. nov.,								×	?
<i>E. hollandi</i> sp. nov.,							×		
<i>E. depressa</i> sp. nov.,								×	
<i>E. obscura</i> sp. nov.,								×	
<i>E. pusilla?</i> Hay,			×					×	?
<i>E. uintensis</i> Hay,							×		
Testudinæ:									
<i>Hadrianus corsoni</i> (Leidy),			×					×	
<i>H. utahensis</i> sp. nov.,								×	
<i>H. robustus</i> sp. nov.,								×	
<i>Testudo uintensis</i> sp. nov.,							×		
Trionychidæ:									
<i>Amyda egregia</i> Hay,					×		×		
<i>A. crassa</i> Hay,							×		
<i>A. scutumantiquum</i> (Cope),			×				×		
Lacertilia:									
<i>Glyptosaurus</i> sp. indet.,			×					×	×

SUMMARY OF MATERIAL FORMING THE COLLECTION OF TURTLES FROM THE UINTA FORMATION IN THE CARNEGIE MUSEUM.

	Catalog No.	Geol. Horizon.
Baënidæ:		
<i>Baëna arenosa</i> Leidy,	2356	B.
<i>B. emiliæ</i> Hay,	2159	B.
<i>B.</i> "	3243	B.
<i>B.</i> "	3253	C.
<i>B.</i> "	3257	B, or C.
<i>B.</i> "	3443	B lower.
<i>B.</i> "	3444	B lower.
<i>B. gigantea</i> sp. nov.,	3441	B lower.
<i>B. inflata</i> sp. nov.,	3406	A.
<i>B.</i> "	3137	B.
<i>B.</i> "	3442	B lower.
<i>B. platyplastra</i> sp. nov.,	3227	B.
<i>B.</i> sp. indet.,	2372	B.
<i>B.</i> " "	3246	?
<i>B.</i> " "	3255	B.
<i>B.</i> " "	3247	?
<i>B.?</i> " "	3271	B.
<i>B.?</i> " " (skull)	2956	C.
<i>B.</i> " "	3447	B lower.

Dermatemydidae:		
<i>Anosteira ornata</i> Leidy,.....	2954	C.
Emydidae:		
<i>Echmatemys callopyge</i> Hay,.....	2157	B.
<i>E.</i> ".....	2371	B.
<i>E. douglassi</i> sp. nov.,.....	3244	C?
<i>E. depressa</i> sp. nov.,.....	2936	C.
<i>E. hollandi</i> sp. nov.,.....	3249	B.
<i>E. obscura</i> sp. nov.,.....	3252	C.
<i>E. pusilla?</i> Hay,.....	3282	C.
<i>E. uintensis</i> Hay,.....	3270	B.
<i>E.</i> ".....	2158	B, or C.
<i>E.</i> ".....	2397	B?
<i>E.</i> sp. indet.,.....	2393	B.
<i>E.</i> " ".....	2361	B.
<i>E.</i> " " (skull and neck).....	2387	B.
Testudinidae:		
<i>Hadrianus corsoni</i> (Leidy),.....	3403, 3404	C.
<i>H. robustus</i> sp. nov.,.....	3342	C.
<i>H. utahensis</i> sp. nov.,.....	2343	B, or C.
<i>H.</i> sp. indet.,.....	2376	B.
<i>H.</i> " ".....	3256	B, or C.
<i>Testudo uintensis</i> sp. nov.,.....	2331	B.
Trionychidae:		
<i>Amyda egregia</i> Hay,.....	3254	B.
<i>A.</i> " ".....	3258	B.
<i>A. seutumantiquum</i> (Cope),.....	3272	B.
<i>A.</i> " ".....	3330	?
<i>A.</i> sp. indet.,.....	3254	B.
<i>A.</i> " ".....	3177	C.
<i>A.</i> " ".....	2981	C.
<i>A.</i> " ".....	3260	C.
<i>A.</i> " ".....	3134	B.
<i>A.</i> " ".....	3050	C.
<i>A.</i> " ".....	3019	B.
<i>A.</i> " ".....	3245	C.
<i>A.</i> " ".....	3285	C.
<i>Incertae sedis:</i>		
Gen. and sp. indet.....	2394	B.
" " " ".....	2374	B.
Fragments of <i>Baëna</i> , <i>Amyda</i> , etc.,.....	3250	C.
Gen. and sp. indet.,.....	2982	C.
" " " ".....	2395	B.
" " " ".....	3445	B?
Anguidae:		
<i>Glyptosaurus</i> sp. indet.,.....	3405	C.

Family BAËNIDÆ Cope.

In the present collection from the Uinta formation of Utah nineteen specimens were sufficiently well preserved to be identified as pertaining to the genus *Baëna*. These were found in all three subdivisions of the Uinta, being distributed as follows: one specimen, *Baëna inflata*, from Horizon A; thirteen from Horizon B; two from horizon C; and three for which the data for the horizon were uncertain, or not given.

Five species of this genus are now recognized as occurring in the Uinta formation, three of which are here described as new. Only one of the recognized species, *Baëna arenosa*, is found to occur in other geological epochs, and no member of this family is known to range above the Uinta.

Genus BAËNA Leidy.

1. *Baëna arenosa* Leidy.

Plate XVIII, fig. 1; text-fig. 1.

Baëna arenosa LEIDY, Proc. Acad. Nat. Sci. Phila., 1870, p. 123; U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 367; U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 368; Contrib. Ext. Vert. Fauna West. Terrs., 1873, pp. 161, 343, pl. 13, figs. 1-3; ?pl. 15, figs. 1-5; pl. 16, figs. 8, 9.—COPE, ?Append. LL of Ann. Report Chief of Engineers, 1875, p. 96; ?Wheeler's Surv. 100th Merid., 1877, p. 52, pl. 24, fig. 32.—BAUR, Proc. Acad. Nat. Sci. Phila., 1891, p. 426.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437; Foss. Turtles of N. A., 1908, pp. 67-71, pl. 12; pl. 13, fig. 1; pl. 14, figs. 1-3, text-figs. 44-51.
Baëna affinis LEIDY, Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 367.

This species is represented in the collection by a single specimen, Cat. No. 2356. Collected by Earl Douglass and party, June 18, 1908, from Horizon B, Uinta formation, Upper Eocene, east of Dragon-Vernal road between White and Green Rivers, Uinta Basin, Uinta County, Utah.

The specimen consists of a fairly complete carapace, lacking the posterior borders and the peripherals of both sides, the plastron lacks portions of both anterior and posterior lobes. It represents an individual of approximately the same size as the type of the species (Cat. No. 103, U. S. National Museum), with which it has been carefully compared. This comparison shows several differences, but such as exist are not considered of sufficient importance to separate the specimens specifically. The sculpture of the carapace is rough and uneven, consisting

of various longitudinal, transverse and oblique ridges, especially within the areas of the vertebral scutes, this part of the carapace being fairly smooth in the type.

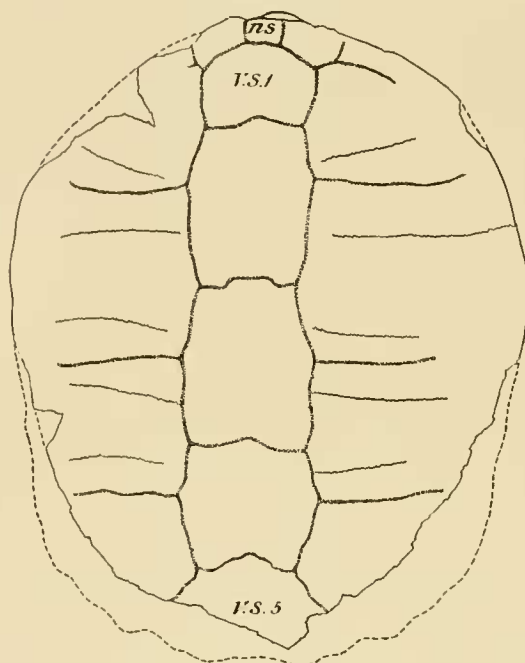


FIG. 1. Carapace of *Baëna arenosa* Leidy. C. M. No. 2356. $\times \frac{1}{4}$. ns., neural scute; v.s. 1-v.s. 5, vertebral scutes one and five.

In the measurements of the vertebral scutes it also differs from the type, but agrees almost exactly with the type of *Baëna affinis* Leidy, which is now regarded by Hay, following Leidy and Cope, as being a synonym of *B. arenosa*. The vertebral areas of this type are also in accord with the present specimen. In order to show the close agreement of the present individual with the above-mentioned specimens a table giving the comparative measurements of the vertebral scutes of each is herewith appended.

COMPARATIVE MEASUREMENTS OF VERTEBRALS.

	Length.			Width.		
	No. 2356.	Type of <i>B. arenosa</i> .	Type of <i>B. affinis</i> .	No. 2356.	Type of <i>B. arenosa</i> .	Type of <i>B. affinis</i> .
1	44	—	50	57	—	72
2	76	77	73	62	73	61
3	76	74	73	64	77	64
4	60	61	60	68	78	63
5	—	68	55	88	96	75

Since the anterior portion of the carapace is missing in the type of the species and in all subsequently discovered specimens the complete anterior margin in the

present specimen is therefore worthy of brief description. The nuchal scute is small, having a length of 12 mm., and a transverse diameter of 17 mm. The median part of the anterior border projects slightly beyond the general contour of the shell. The nuchal is flanked on either side by small rectangular marginals. The arrangement and proportions of the scutes in front of the first vertebral are very similar to those of *Baëna antiqua* Lambe.

This specimen shows many of the sutures between the costals, but on the median dorsal surface their complete coalescence renders it impossible to differentiate the neurals. There are no supernumerary costal scutes on either side of the first vertebral such as found in many species of this genus and occasionally in individuals pertaining to the present species.

The plastron agrees almost exactly with the type in size and proportions, and especially in the sculpture of the surface and the course of the various sulci. The accompanying table gives a comprehensive comparison of the principal measurements of the plastra.

COMPARATIVE MEASUREMENTS OF PLASTRA.

	No. 2356.	Type of <i>B. arenosa</i> .	Type of <i>B. affinis</i> .
Width of bridge.....	145	140	125
Length of anterior lobe.....	82	77	77
Width of anterior lobe.....	108	107	104
Width of posterior lobe.....	96	98	114

The discovery of the present specimen in the Uinta formation of Utah increases somewhat the known geographical as well as the geological range of *Baëna arenosa*. The type of the species is from the Bridger deposits at the junction of the Big Sandy and Green rivers in southeastern Wyoming. Hay⁴ has identified this species from the Washakie, the uppermost division of the Bridger. The type of *B. affinis* is from level B, of the Bridger, which represents the middle of that formation. Both Cope and Hay have identified specimens from the Wasatch of New Mexico as pertaining to this species, these being the most ancient known at the present time. With a geological range beginning in the Wasatch and ending in the middle of the Uinta, *Baëna arenosa* enjoys the distinction of having the widest geological distribution of any species of the genus.

2. *Baëna emiliæ* Hay.

Baëna emiliæ HAY, O. P., Fossil Turtles of North America, 1908, pp. 80-81, Pl. XX, fig. 1; text-figs. 67, 68.

Six specimens in the present collection are identified as pertaining to *Baëna*

⁴ Hay, O. P., "Fossil Turtles of North America," Pub. Carnegie Institution, Washington, 1908, pp. 67-68.

emiliae Hay. The better preserved specimen, C. M. No. 3443, consists of a nearly complete carapace and plastron, the former lacking small portions of the hinder borders posterior to the inguinal notches. The missing margin of the right side was apparently lost in life, as shown by the healed condition of the bone at this point. The specimen was collected by Earl Douglass during the season of 1915 at Wagon-hound Bend, on White River, Uinta County, Utah, from the lower part of Horizon B. It will be seen from the table of comparative measurements given below that this specimen has about the same dimensions as the type of the species. It differs, however, in the more angularly rounded contour of the front lobe, a feature in which it also is different from three of the other specimens here referred to this species. Whether this difference represents a sexual character, or is only an individual variation, I am unable to determine.

In many respects the present specimen is very close to the type of *Baëna clara* from the Bridger formation, but the great length of the third vertebral scute, as compared with the others of the series, is regarded by Hay as one of the chief distinguishing characters of the species, and together with the much shorter posterior lobe, as compared with the longer lobe in *B. clara*, appears to show that its closest affinities are with the present species.

An anterior portion of a carapace and plastron, C. M. No. 3253, on account of its close general resemblance to the specimen discussed above, is provisionally referred to the same species. This specimen is from Horizon C of the Uinta formation and is the only individual in the collection, referred to the present species, which is positively known to have come from that horizon, all of the others having been found in strata belonging to Horizon B. It was collected by Earl Douglass two or three miles west of Well No. 2, Uinta County, Utah.

A third specimen, C. M. No. 2159, consisting of a complete plastron and the entire central part of the carapace, but lacking portions of both sides, is also referred to this species. It was collected by Earl Douglass in 1908, in the Devil's Playground, Uinta Basin, Uinta County, Utah, from Horizon B (near top) or C (near base).

A fourth individual, C. M. No. 3243, has a nearly complete carapace and plastron, the latter lacking the posterior lobe. It was collected by Messrs. Earl Douglass and J. T. Goetschius, October 2, 1908, about one mile northeast of Well No. 2, "near first gap," Uinta County, Utah, from Horizon B.

The fifth specimen, C. M. No. 3257, consists of a carapace and plastron, the former lacking some of the posterior border. This turtle also was collected by Earl Douglass and J. T. Goetschius, July 30, 1908, south of Kennedy's Hole and

west of the Dragon-Vernal road, Uinta Basin, Uinta County, Utah, from Horizon B, or C.

The sixth specimen, C. M. No. 3244, consists of the greater part of the carapace and plastron. The carapace has portions of the rim missing on both the anterior and posterior ends, the plastron lacks the anterior lobe. The specimen was collected by Earl Douglass in 1915, at Wagon-hound Bend on White River, Uinta County, Utah, from the lower part of Horizon B.

The type of *Baëna emilia* is in the American Museum of Natural History, and was collected by Mr. O. A. Peterson in 1884, from the middle Uinta of Utah. Geologically therefore all of the known specimens, including the type, two other specimens referred to the species by Hay, and the six specimens under consideration, came from approximately the same horizon, and from neighboring localities.

It may be shown hereafter, when larger collections shall have been made, that more than one species is represented by the six specimens here referred to *B. emilia*. When compared with one another there are differences which appear to divide them into three groups, as follows: Nos. 2159 and 3243, having relatively narrower vertebral scutes and narrower plastral lobes and bridges than the type, or other specimens here referred to *B. emilia*; Nos. 3244 and 3257, having wider vertebral scutes and a more depressed shell than the type; and No. 3443 with a wider and more angularly rounded anterior lobe, larger intergulars, and narrower pectorals. The latter specimen in all of these particulars is different not only from the type, but from all of the other specimens discussed above, with the exception of the fragmentary specimen No. 3253, which, in so far as the two can be compared, appears to be very close to No. 3443. In nearly all other respects these specimens agree closely with the type of the species. The differences enumerated above are not considered important enough to warrant the separation of these turtles into distinct species. When the considerable sexual and individual differences observable in a series of living turtles of one species and from one locality are considered, it appears to me that the specimens before me are well within the limits of a given species. I am inclined to the belief that specimens Nos. 2159 and 3243 may be females of this species, but as to this I cannot be certain. The discovery of more material may possibly show that more than one species is represented in these specimens, but at this time, especially in the light of a recent examination of a large series of living turtles, I do not feel justified in the establishment of new species on such slender distinguishing characters as have been observed. For the present, at least, I refer all the six specimens to *Baëna emilia* Hay.

In order to place on record the proportional variations within the species I have prepared the table of comparative measurements given below:

COMPARATIVE MEASUREMENTS OF VERTEBRALS.

	Length.						Width.					
	Type.	No. 3443.	No. 3244.	No. 3257.	No. 2159.	No. 3243.	Type.	No. 3443.	No. 3244.	No. 3257.	No. 2159.	No. 3243.
1	55	53	—	51	47	38	68	73	—	85	65	63
2	80	81	—	82	71	77	63	79	71	87	64	56
3	92	96	97	89	87	88	75	82	80	90	68	63
4	70	69	74	72	69	67	78	77	80	91	69	65
5	70	62	52	—	—	62	98	101	90	—	—	96

COMPARATIVE MEASUREMENTS OF CARAPACE AND PLASTRON.

	Type.	No. 3443.	No. 3244.	No. 3257.	No. 2159.	No. 3243.
Greatest length of carapace.....	368	364	365 _e	375 _e	328	366
“ width “ “	294	292	310	310	—	260
“ length of plastron.....	320	307	—	310 _e	300	—
“ “ anterior lobe.....	80	76	—	75	77	73
“ width “ “	110	105	106	105	102	98
“ length posterior lobe.....	83	84	80	98 _e	80	—
“ width “ “	122	114	119	117	108	105
Width of bridge.....	160	150	149	146	140	146

e, estimated.

3. *Baëna inflata* sp. nov.

Plate XIX; text-figs. 2 and 3.

Type: C. M. No. 3406, consisting of a carapace and plastron, the former lacking the posterior end back of the middle of the fourth vertebral, the latter a small portion of the anterior lobe; collected by O. A. Peterson in 1912.

Locality: McCook Canyon, White River, Uinta County, Utah.

Horizon: Horizon A (near top), Uinta formation, Upper Eocene.

The type of this species is but little crushed and, except for the parts which are missing, is in a beautiful state of preservation. The surface of the carapace and plastron are everywhere covered with fine pustular elevations, forming a shagreened surface. The pustules on the carapace are coarser than those on the plastron. The surface of the carapace is also somewhat uneven, and laterad to the second, third, and fourth vertebrae there are some heavy longitudinal wrinklings. These are most numerous laterally at the junction of the third and fourth vertebrae. The pustular ornamentation of the carapace appears to be very similar to that of *Baëna sima* Hay, but not so coarse.

The greatest length of the shell is estimated to have been about 400 mm.; its greatest width at the center is 310 mm. In outline the front of the shell is evenly,

but broadly, rounded, resembling in its general contour *B. sima* Hay. The shell is flat transversely in the region of the vertebral scutes, but from one border to the other it is broadly convex. One of the distinctive features of this species is the decided transverse inflation or swelling of the mid-costal region, which gives the shell the appearance of being puffed out on the sides. This swelling lies largely within the areas of the second costal scutes, and it is to this feature that the specific name refers.

Over the posterior legs the margins of the shell begin to flare outward and slightly upward, and at this point the border is heavy and rounded but becomes thinner posteriorly. In front of the axillary notches the border has a thickness of 31 mm., but rapidly thins toward the center, where it measures only 8 mm., the edge being obtusely rounded. The bones of the carapace are so thoroughly coösfied that but few of the sutures can now be made out. The sulci, however, can in most instances be clearly traced.

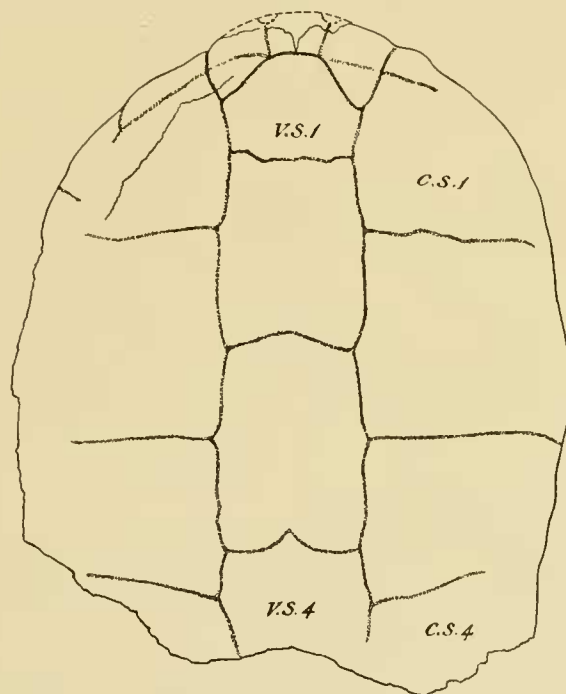


FIG. 2. Carapace of *Baëna inflata*. C. M. No. 3406, Type. *C.S. 1*, *C.S. 4*, costal scutes one and four; *V.S. 1*, *V.S. 4*, vertebral scutes one and four. One-fourth natural size.

The vertebrals as in nearly all Eocene Baënidæ are longer than wide. The sides of the vertebrals, excepting the first, which is hexagonal with a very narrow anterior end, are bracket-shaped. It will be observed, that, as in *Baëna emiliæ*, the third vertebral is the longest of the series. Along the center of vertebrals two,

three, and four is a narrow low ridge, on either side of which are parallel grooves much as in *B. emilia*. The principal dimensions of the vertebrals as well as those of a second individual, C. M. No. 3442, referred to this species, are given in the accompanying table.

DIMENSIONS OF VERTEBRALS.

	Length.		Width in front.		Greatest width.	
	Type.	No. 3442.	Type.	No. 3442.	Type.	No. 3442.
1	61	53	28	75	72	75
2	90	92	62	63	74	77
3	99	98	62	64	78	81
4	—	90	68	70	78	81
5	—	—	—	53	—	—

The nuchal scute is rectangular, being about 17 mm. long and 30 mm. wide on the free border. It is bordered on either side, as shown in specimen No. 3442, by small triangular first marginals. The second marginal has its greatest width

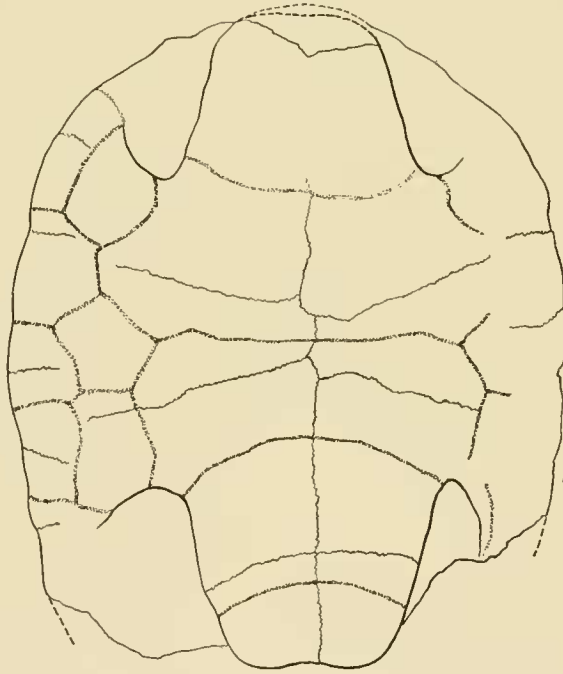


FIG. 3. Plastron of *Baëna inflata* C. M. No. 3406, Type, restored after C. M. No. 3442. One-fourth natural size.

(36 mm.) on the free border. The first vertebral is bordered on either side by small triangular supernumerary costal scutes, though there is no indication of these in specimen No. 3442.

It is estimated that the plastron had a total length of about 365 mm. It is

slightly convex transversely throughout its length, and this convexity on the bridge area continues evenly to the borders of the shell, so that these borders stand 36 mm. above the level of the plastron at the center. The anterior lobe has its greatest width (135 mm.) at the base; and at a point half-way to the anterior end it measures 99 mm. The sides of the lobe converge gradually from the base to the anterior end, which appears to have been rounded. The width of the bridge is 175 mm.

The posterior lobe is tongue-shaped, shallowly, but broadly notched. Its length on the midline is 97 mm., with a width at the base of 139 mm. The notch has a depth of 6 mm. at the center.

Excepting those of the anterior lobe all of the sulci and sutures on the plastron can be clearly made out. The mesoplastrals widen rapidly on either side of the midline. At the center the right scute measures 51 mm. The width of the right hypoplastral at the center is 104 mm.; of the left hypoplastral 91 mm. The xiphoplastrals are 62 mm. wide on the midline. The pectorals meet on the midline for a distance of 75 mm.; the abdominals for 49 mm.; the femorals for 80 mm.; the anals for 47 mm.

On the right side are three inframarginal scutes, the form of which is well shown in Fig. 3.

A second specimen, C. M. No. 3442, belonging apparently to this species, was collected by Earl Douglass in 1915 from the lower part of Horizon B of the Uinta formation, at Wagon-hound Bend on White River, Uinta County, Utah. This turtle consists of a carapace and plastron, both of which have small portions missing from their posterior ends. In size, general contour, and the dimensions of the dermal scutes, the specimen closely resembles the type. The inflation of the sides of the carapace, which forms such a conspicuous feature in the type, is almost entirely wanting in this individual. Its absence may be attributed in part, at least, to crushing, for both sides in this respect have somewhat suffered. There are also no supernumerary costal scutes at either side of the first vertebral, and in their absence the first vertebral is tetragonal, whereas in the type it is hexagonal with the narrow end in front. This specimen shows small triangular first marginals on either side of the nuchal, and in the drawing of the type (Fig. 2), this region, which is missing, has been restored after this specimen. It also gives the complete form of the anterior lobe (See Fig. 3), which in its general contour closely resembles *Baëna sima* Hay.

The greater part of an anterior lobe, C. M. No. 3137, which was collected by Earl Douglass in the strata of Horizon B of the Uinta formation, near Well No. 2, Uinta Basin, Utah, in 1908, is regarded as belonging to *Baëna inflata*. It is from

an individual having the same proportions as the type, and shows on the dorsal surface the triradiate shape of the entoplastron (See Fig. 4, 1). The entoplastron

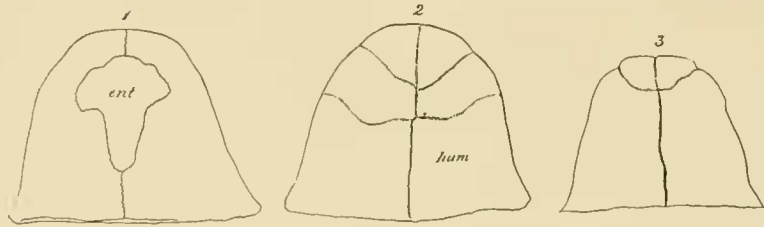


FIG. 4. Anterior lobes of *Baëna inflata*. 1, and 2, superior and inferior views of C. M. No. 3137, *ent.*, entoplastron; *hum.*, humeral scute. 3, inferior view of anterior lobe of C. M. No. 3442. All figures one-fourth natural size.

has a length of at least 50 mm.; a width of 44 mm. Transversely the lower surface of the lobe is broadly convex. On the dorsal surface immediately posterior to the anterior border the bone is scooped out by a shallow transverse depression. The lateral borders are bevelled off almost perpendicularly, while in front the border is rounded. The bone along the borders has a thickness of 13 mm., in front of the center of only 9 mm., at the middle on the posterior broken border of 21 mm.

4. *Baëna gigantea* sp. nov.

Plate XX, figs. 1 and 2; text-figs. 5, 6, and 7.

Type: C. M. No. 3441, consisting of nearly a complete shell. The carapace lacks portions of the posterior margins on either side of the middle, a small section of the right anterior border, and the peripherals of the right side above the bridge. The plastron has the greater part of the posterior lobe missing. Collected by Earl Douglass, in 1915.

Locality: Wagon-hound Bend, on White River, Uinta County, Utah.

Horizon: Lower part of Horizon B, Uinta formation, Upper Eocene.

The type of the present species is the largest species of the genus as yet discovered. It is estimated that the carapace had an axial length of about 535 mm. The greatest width, which is near the center, is about 420 mm. The bones of the carapace are all thoroughly coössified and only the sutures defining the right half of the mesoplastron can be detected and then only with difficulty. The shell is oval in outline, in this respect resembling *Baëna clara* Hay, though the oval is somewhat more elongate than in that species. The carapace has been slightly crushed on the right side, as may be seen by examining Plate XX, fig. 1.

The front of the carapace is decidedly projecting. The missing posterior

borders render it impossible to determine the character of the scallops on the hinder end. The surfaces of both the carapace and plastron are roughened with coarse pustular elevations, though these are more sparsely placed than in either *Baëna sima* or *B inflata*. With the exception of this pustular roughening the surfaces are comparatively smooth, there being no longitudinal ridges or grooves, such as are commonly found in many species of this genus from the Eocene. The vertebral areas are also free from median ridges and channels.

The nuchal scute resembles in outline that of *Baëna hatcheri*. It has a fore-and-aft diameter of about 58 mm., and a transverse diameter of 88 mm. The

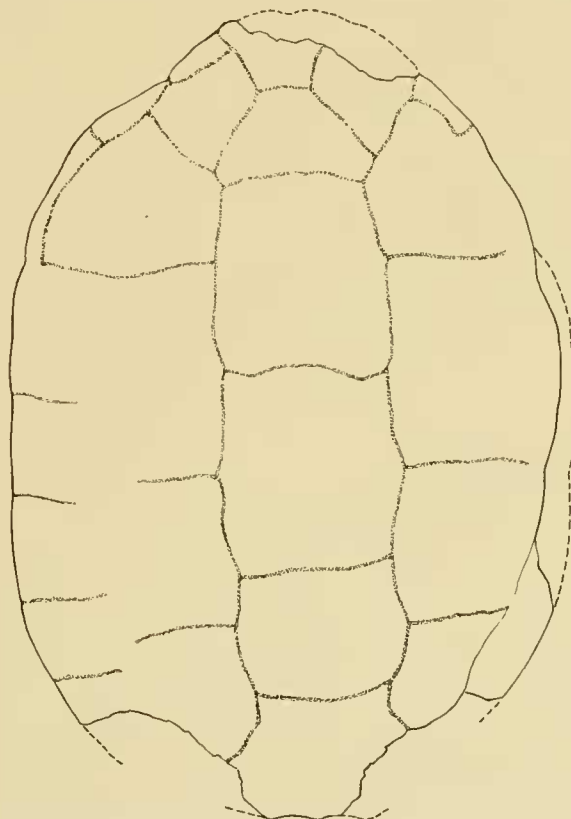


FIG. 5. *Baëna gigantea*, carapace of C. M. No 3441, Type. About one-fifth natural size.

unusual length of the nuchal appears to be one of the distinctive features of this species. All of the sulci are distinctly impressed. At the left side of the nuchal is a subrectangular first marginal, which has a length on the free border of 43 mm. The total number of peripherals cannot be determined from this specimen.

There are the usual five vertebrals and these are relatively wide, and differ from those of all other Eocene Baënidæ, except *B. emiliae*, in having the fourth considerably wider than long. The sides of the vertebrals posterior to the first are

only slightly bracket-shaped. The first is hexagonal, very narrow in front, in this respect closely resembling the first in *Baëna inflata*. The surfaces within the first, second, and third vertebral areas are flattened, but the fourth and fifth are transversely broadly convex. The principal dimensions of the vertebrals are given in the accompanying table.

DIMENSIONS OF VERTEBRALS.

	Length.	Width in front.	Greatest width.
1	58	34	98
2	122	87	105
3	126	96	113
4	88	94	106
5	102 ^e	88	152 ^e

^e, estimated.

As in *Baëna riparia* Hay and *B. hatcheri* Hay, there are five costal scutes. A small supernumerary scute is situated on each side of the first vertebral, showing a difference from the former species by bordering on the nuchal, whereas in *B. riparia* these scutes are not in juxtaposition.

On the plastron only the sutures defining the mesoplastron on the right side

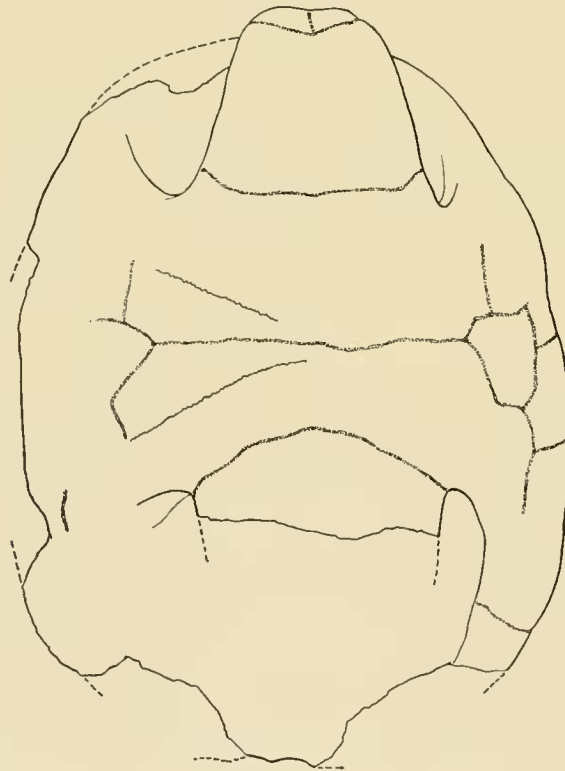


FIG. 6. *Baëna gigantea*, plastron. Type, C. M. No. 3441. About one-fifth natural size.

are traceable, and these show them to be narrow at the midline (18 mm.), but expanding toward their outer extremities where the width is 112 mm. The anterior lobe is elongated antero-posteriorly, and turns upward with a well-defined sweep toward the carapace, as shown in Fig. 7. Its greatest length is 137 mm.; its greatest width 170 mm. at the base; at a point half-way to the tip measuring 117 mm. in width. The sides of this lobe gradually converge from the base to near the anterior end, which rounds in with a shallow but broad median emargination on the anterior end. The posterior lobe is largely missing, though enough of the base remains to show that it had a width of 160 mm. The width of the bridge is 190 mm.

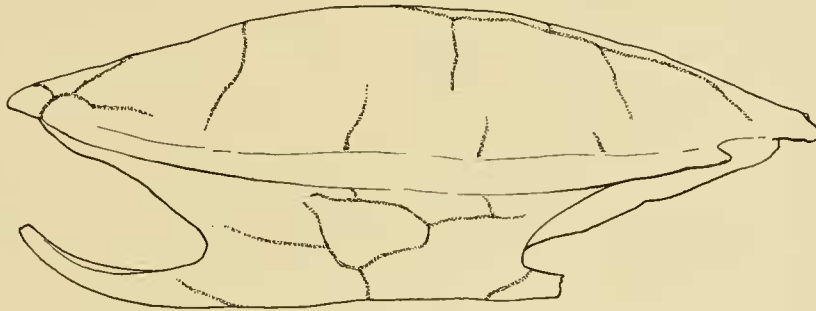


FIG. 7. *Baëna gigantea*, lateral view of the carapace and plastron, C. M. No. 3441. Type specimen, one-fifth natural size.

The sulci defining the intergular scutes cannot be traced. The intergulars meet on the midline for a distance of 29 mm.; the humerals 112 mm.; the pectorals 97 mm.; the abdominals 55 mm. The number of inframarginals on the bridge cannot be determined in this specimen.

This species may be distinguished from all others of the genus by its larger size, the great length of the nuchal scute, and differences in the relative dimensions of the vertebral scutes. The contour of the anterior lobe of the plastron, its greater relative length, and especially its decided upward curvature are all features which serve to distinguish this species. In the presence of five costal scutes the type of this species agrees with several species of the genus, especially *Baëna ripariã* and *B. hatcheri*, but it differs from those forms by the decidedly longer nuchal scute and in the apparent absence of marginal scutella. In the greater length of the third vertebral this specimen is like *B. emilia* from the same formation, but the greater relative widths of all of the vertebrales and especially the shortness of the fourth, together with other differences to be observed in the plastron, at once distinguish it from that species.

5. *Baëna platyplastra* sp. nov.

Plate XVIII, fig. 2; text-fig. 8.

Type: C. M. No. 3227, consisting of a plastron lacking the anterior portion of the anterior lobe, matrix cast of the carapace, at either end of which remain a few fragmentary parts of the carapace. Collected by Earl Douglass and J. F. Goetschius, August 5, 1908.

Locality: Northeast of Well No. 2, Uinta Basin, Uinta County, Utah.

Horizon: Horizon B, Uinta formation, Upper Eocene.

The type specimen represents one of the larger species of the genus. It is distinguished from all other described species of *Baëna* by the extremely flat and thin plastral bones with sculptured inferior surfaces. Its large size and the absence of a median emargination on the posterior lobe are features which also assist in distinguishing this species.

The ornamentation of the plastron consists of low ridges and shallow furrows, the former being short, sometimes straight, but usually bent or anastomosing. The effect of the whole may be best expressed as resembling a coarse, shagreened

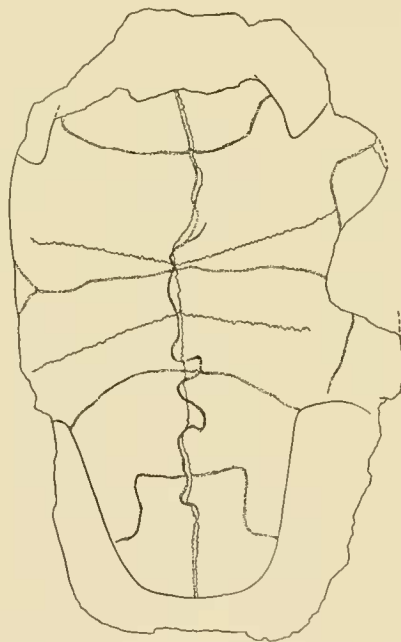


FIG. 8. Plastron of *Baëna platyplastra*, C. M. No. 3227. Type, one-fourth natural size.

leather. The sutures in the type have all coalesced, but their courses are indicated by ridges crossing them at right angles. These cross-ridges are especially pronounced on the median suture between the axillary notches.

It is estimated that the entire shell had a length of about 495 mm., and a height at the center of about 170 mm. The plastron had a length of about 420 mm. The anterior lobe at the base is 156 mm. wide. The bridge is 180 mm. wide.

The posterior lobe has a width at the base of 152 mm., and a length of 128 mm. The lateral borders of the lobe are nearly straight and converge nearly the entire length of the lobe, there being a slight constriction at the anal-femoral sulcus. The posterior end of this lobe is broadly but evenly rounded and without median emargination. At the anal-femoral sulcus the transverse measurement is 107 mm.

The mesoplastrals are solidly coössified with the contiguous bones and their boundaries can only be determined by the ridges which cut them at right angles. At the midline these bones have a width of 33 mm., at their outer ends they expand to 55 mm. in width.

As in *Baëna sima* Hay, the median sulcus runs a very tortuous course, as is well shown in Fig. 8. The pectorals meet on the median line for a distance of 77 mm.; the abdominals for 70 mm.; the femorals for 68 mm.; the anals for 85 mm. The anal-femoral sulcus runs in from the border a short distance, then turns abruptly forward, then again turns at right angles toward the median line to meet the scute of the opposite side. In the shape of the anal scutes it resembles *Baëna arenosa* and more especially *B. clara*.

Owing to the damaged condition of the bridges the number of inframarginal scutes cannot be determined.

Family DERMATEMYDIDÆ Gray.

The family Dermatemydidæ is represented now for the first time in the Uinta formation by the single genus and species, *Anosteira ornata* Leidy. This is the latest recorded occurrence of this genus for North America, although in England it is known to range upward into the Lower Oligocene.

Genus ANOSTEIRA Leidy.

6. *Anosteira ornata* Leidy.

Anosteira ornata LEIDY, Proc. Acad. Nat. Sci. Phila., 1871, p. 102; Ann. Report U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 370; Contrib. Ext. Fauna West. Terrs., 1873, pp. 174, 341, pl. XVI, figs. 1-6.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 447; Bull. Amer. Mus. Nat. Hist., XXII, 1906, p. 157, figs. 2, 3; Fossil Turtles of North America, 1908, pp. 279-281, Pl. XLIII, figs. 1, 2; text-figs. 352-354.

Anostira ornata COPE, Ann. Report U. S. Geol. Surv. Wyoming, etc., 1872 (1873), p. 621; Amer. Naturalist, vol. XVI, 1882, p. 989, fig. 7; Vert. Tert. Form. West, 1884, p. 128.—DOLLO, Bull. Mus. Roy. Belgique, IV, 1886, p. 93, Pl. XI, figs. 7, 8.

A fragmentary specimen, No. 2954, collected by O. A. Peterson August 24, 1912, from Horizon C, Uinta formation, on White River near Ouray, Uinta County, Utah, is provisionally identified as pertaining to the above genus and species. This specimen consists of the articulated nuchal, first and second neurals, with portions of the abutting costals of both sides, parts of several disarticulated costals, eleven peripherals, several of which are complete. The plastron is represented by the right hypoplastron lacking a portion of its outer extremity and many fragmentary parts.

The specimen has been carefully compared with the figures and descriptions given by Leidy and Hay, and especially with one of Leidy's cotypes No. 4062, now in the U. S. National Museum, and, with the exception of slight differences in size, it agrees closely in nearly all respects. The present specimen is of about the same size as one individual in the American Museum of Natural History described and figured by Hay in his Turtles of North America, but is considerably smaller than the cotype of Leidy mentioned above.

All of the specimens described by Leidy are supposed to have come from the lower portion of Horizon B in the Bridger as exposed in the neighborhood of old Fort Bridger, Wyoming. The specimen described by Hay in the publication cited is from the third division of Horizon C of the Bridger on Henry's Fork, Wyoming. The discovery of the specimen considered here now extends the geological range of this species into the uppermost horizon of the Uinta formation.

The nuchal has a length of 15 mm., a width on the free border of 23 mm. The free border is subacute and is not so deeply excavated in front as in the specimen figured by Leidy. The thickness of the nuchal at the midline is 5 mm.

The first neural has a length of 13 mm., and a greatest width of 6 mm. The bone is coffin-shaped with the widest end forward. The second neural is 9 mm. long, and only 4 mm. wide.

All of the bones of the carapace are delicately sculptured, though those of the anterior part of the shell appear less distinct than in most of the described specimens. The few costals present show the usual low undulating ridges crossing them at right angles to their shorter diameters. This sculpture is most distinct toward their outer ends. The peripherals have their upper and lower surfaces ornamented by the usual sharp ridges and pustular elevations.

The few sulci discernible are narrow and delicately impressed. As in previously described specimens the intramarginal sulci on the nuchal and anterior peripherals cannot be traced. The first vertebral has a greatest width of 26 mm., whereas in the specimen described by Hay it is only 18 mm. The sulcus forming the posterior boundary of the first vertebral crosses the first neural as in other described specimens. The costal sulcus on the second costal is near the center of that bone, while in the specimen described by Hay it is very close to the posterior border.

The right hypoplastron is 21 mm. long on the midline, and has a thickness of 5.5 mm. The sculpture on the lower surface of this bone is made up of fine ridges arranged in a radiating pattern. There is no evidence of epidermal scutes on any of the plastral bones found with this specimen.

Cope has recognized this species from the Upper Green River beds, so that the evidence at hand shows that this species ranges from the lowest horizon in the Bridger deposits to the highest horizon in the Uinta formation, the uppermost Eocene.

Family EMYDIDÆ Gray.

Genus ECHMATEMYS Hay.

In 1908 Hay⁵ recognized nineteen species as pertaining to the genus *Echmatemys*. Since that time he has described one new form,⁶ so that with the four new species described in the present paper, twenty-four species have been recognized from the fossiliferous deposits of North America. Seven of these have now been found in the Uinta formation and increased collections will doubtless show the presence of several more. The discovery in the present collection of *Echmatemys septaria* (Cope) leads to the belief that still other species known in the older Wasatch and Bridger beds, will sooner or later be found to continue into the uppermost Eocene.

6. *Echmatemys callopyge* Hay.

Plate XXI; text-figs. 9 and 10.

Echmatemys callopyge HAY, Fossil Turtles of North America, 1908, 340-342, Pl. LII, figs. 1, 2; text-figs. 447, 448.

Two specimens in the Carnegie Museum are identified as belonging to this species. The better preserved specimen, No. 2371, was collected by Earl Douglass in 1908, from Horizon B, "above second sandstone with small artiodactyls,"

⁵ "Fossil Turtles of North America," 1908, p. 298.

⁶ Proc. U. S. National Museum, XXXV, 1908, pp. 164-166.

Uinta formation, Upper Eocene, east of Dragon-Vernal road between White and Green rivers, Uinta Basin, Uinta County, Utah. The second specimen, No. 2157, was also collected by Douglass from the same geological horizon near Well No. 2, in the Uinta Basin. Like the type, both of these specimens have the carapace somewhat crushed over toward the left side. The type of the species is said by Hay to have come from the middle Uinta, and it appears probable that all of these specimens were found at about the same geological level.

Hay considered the very narrow first vertebral as the chief distinguishing character for separating this species from the others of the genus, but both of the

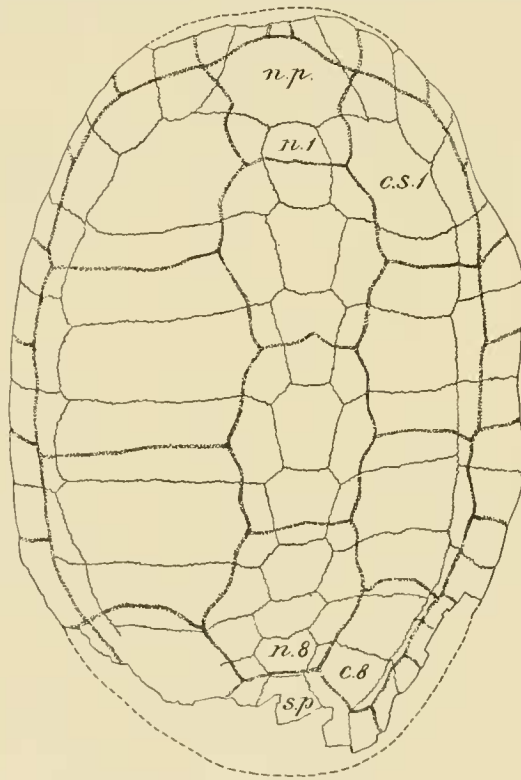


FIG. 9. *Echmatemys callopyge* Hay. Carapace of C. M. No. 2371. One-fourth natural size. *c. 8*, costal plate; *c.s. 1*, first costal scute; *n. 1*, and *n. 8*, neurals one and eight; *n.p.*, nuchal plate; *s.p.*, suprapygal.

specimens before me have this scute relatively wider than in the type, although in nearly all other respects, as is shown by the table of comparative measurements, the specimens are remarkably similar. So far as the width of the first vertebral is concerned these specimens are intermediate between the type of the present species and the figured specimen of *Echmatemys septaria* (Cope), as illustrated by Hay, *Fossil Turtles of North America*, Fig. 415, p. 320. The type of the latter species is in the U. S. National Museum (No. 4088), and consists of a fairly complete

plastron, a portion of the central part of the carapace, including the third, fourth, and fifth neurals with portions of the second, third, and fourth costals: and a small piece of the fifth, sixth, and seventh costals with abutting peripherals. It was collected in the badlands of South Bitter Creek, Wyoming, from the beds of the Washakie Basin.

I have carefully compared the specimens before me with the above mentioned type and except for differences in size, find them, so far as they can be contrasted, remarkably similar. The broad, hatchet-shaped anterior lobe so characteristic of *Echmatemys septaria* is duplicated in these specimens.

In the type of *Echmatemys callopyge* the front two-thirds of the first vertebral lies wholly within the lateral borders of the nuchal plate, and, although relatively wider, this is also true of specimen C. M. No. 2157, but specimen C. M. No. 2371 has the antero-lateral angles of the first vertebral extending across the lateral sutures of the nuchal. In a specimen identified by Hay as pertaining to *Echmatemys septaria* (See Fossil Turtles of North America, Fig. 415, p. 320) the first vertebral extends entirely over the lateral boundaries of this plate. From the intermediate condition observed in the present specimens, the first vertebral would appear to be subject to considerable variation and therefore its narrowness cannot be relied upon as a constant specific difference. Specimen C. M. No. 2371

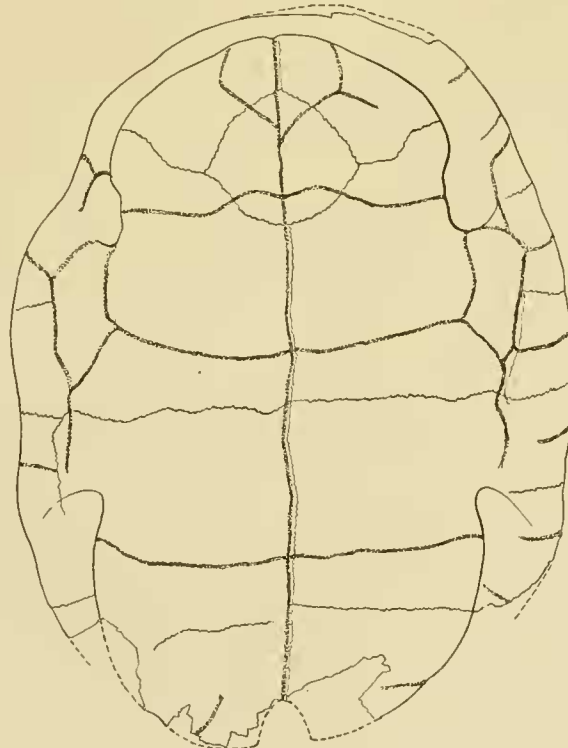


FIG. 10. *Echmatemys callopyge* Hay. Plastron of C. M. No. 2371. One-fourth natural size.

has the surface of the carapace smooth, with the exception that, as in the type of *E. septaria*, it is relieved by faint striations and growth lines, these being especially apparent within the areas of the vertebral scutes.

MEASUREMENTS OF NEURALS.

No.	Length.			Width.		
	Type.	No. 2157.	No. 2371.	Type.	No. 2157.	No. 2371.
1	52	50	50	33	35	36
2	43	—	40	39	—	41
3	58	—	43	43	—	39
4	41	41	38	37	38	34
5	41	26	35	44	—	41
6	30	—	29	40	—	39
7	29	25	25	45	—	40
8	28	—	23	34	—	35

MEASUREMENTS OF VERTEBRALS.

No.	Length.			Width.		
	Type.	No. 2157.	No. 2371.	Type.	No. 2157.	No. 2371.
1	75	81	77	52	71	77
2	89	90±	85	85	87	86
3	88	96	87	82	95	76
4	96	—	86	87	100	84
5	74	—	—	100±	—	—

PRINCIPAL MEASUREMENTS CARAPACE AND PLASTRON.

	Type.	No. 2157.	No. 2371.
Greatest length of carapace.....	438	420±	415
Greatest width of carapace.....	270	276	279
Greatest height of carapace.....	153	160	133
Nuchal, greatest length.....	68	69	66
Nuchal, greatest width.....	90	86	80
First marginal, greatest length.....	40	43	40 ^e
First marginal, greatest height.....	32	34	28
Plastron, greatest length.....	410	422	370
Anterior lobe, greatest length.....	116	125	107
Anterior lobe, width at base.....	174	180	176
Posterior lobe, greatest length.....	135	140	—
Posterior lobe, width at base.....	198	205	195
Bridge, width.....	155	165	162
Lip, width.....	38	44	45
Entoplastron, width.....	52	66	75
Gulars, meet on the midline.....	72	67	58
Humerals, meet on the midline.....	35	34	36
Pectorals, meet on the midline.....	74	76	73
Abdominals, meet on the midline.....	110	114	102
Femorals, meet on the midline.....	38	41	33
Anal, meet on the midline.....	66	62	—

Had *E. callopyge* not been established, I should have unhesitatingly referred both of the specimens discussed above to *Echmatemys septaria* (Cope). For the

present, however, it will serve all purposes to assign them to the established Uinta species, until the discovery of additional Bridger material shall definitely determine whether two distinct species are represented by this material, or whether *E. callopyge* Hay shall become a synonym of the earlier described *E. septaria* (Cope).

In order to place on record the variation within the species, some of the principal measurements of the two specimens here considered as compared with those of the type of the species are given in the preceding table.

7. *Echmatemys uintensis* Hay.

Echmatemys uintensis HAY, Fossil Turtles of North America, 1908, pp. 342, 343. Pl. LIII, figs. 1, 2.

The above species is represented in the Carnegie Museum collections by three specimens. The better preserved specimen, C. M. No. 3270, consists of a carapace and plastron, the former lacking a portion of the posterior end and a considerable part of the costals and peripherals of the right side. The plastron is complete. This specimen was collected by Earl Douglass, May 25, 1908, from Red Bluff Wash, on the road from Bonanza to Kennedy's Hole, Uinta Basin, Utah, from Horizon B, "transition beds. First sandstone above red layer," Uinta formation, Upper Eocene.

The second specimen, No. 2158, consists of a carapace lacking most of the costals and peripherals of the left side, was collected by Earl Douglass, August 22, 1908, two or three miles below Well No. 2, from Horizon B, Uinta formation, as exposed in the Uinta Basin, Utah.

The third specimen, No. 2397, consists of considerable portions of the carapace and plastron of a large individual, both of which are rather fragmentary. This specimen was collected by Messrs. Earl Douglass and J. F. Goetschius, August 17, 1908, from Horizon B, "grey beds below red and grey beds," Badlands south of Kennedy's Hole, Uinta County, Utah.

This species is based upon a beautifully preserved specimen, No. 11,198, in the paleontological collection of Princeton University. It was collected in 1891 from the middle Uinta, on White River, Utah, and until the discovery of the present specimens was the only known representative of the species.

The specimens before me add but little to our knowledge of the species, but I believe it important to give at this time their principal dimensions as compared with the type in order to show the variations within the species.

COMPARATIVE MEASUREMENTS OF NEURALS.

No.	Greatest length.				Greatest width.			
	Type.	No. 3270.	No. 2158.	No. 2397.	Type.	No. 3270.	No. 2158.	No. 2397.
1	60	59	57	—	45	43	47	—
2	43	55	45	—	42	48	56	—
3	50	55	61	69	42	44	54	55
4	50	47	48	59	43	44	45	52
5	34	—	45	53	47	41	48	60
6	30	—	—	38	42	—	45	59
7	20	—	—	28	50	—	—	64
8	25	—	—	37	30	—	—	—

COMPARATIVE MEASUREMENTS OF VERTEBRALS.

No.	Greatest length.				Greatest width.			
	Type.	No. 3270.	No. 2158.	No. 2397.	Type.	No. 3270.	No. 2158.	No. 2397.
1	70	88	81	—	112	82	100	—
2	115	111	99	120	102	77	88	114
3	91	102	100	117	81	80	80	94
4	78	—	—	110	94	—	98	120
5	86	—	—	—	132	—	—	—

COMPARATIVE MEASUREMENTS OF THE PLASTRON.

	Type.	No. 3270.	No. 2397.
Greatest length, plastron	460	480	515 ^e
Greatest width, plastron	295	390 ^e	—
Length, anterior lobe	120	135	—
Width, anterior lobe at base	200	240	—
Width of lip	65	90	—
Length of entoplastron	70	90	—
Greatest width of entoplastron	95	96	—
Length of posterior lobe	150	154	185
Width of posterior lobe at base	200	230	240
Depth of posterior median notch	16	19	20 ^e
Width of notch	55	55	—
Epiplastrals meet on midline	44	43	—
Hyoplastrals meet on midline	125	108	114
Hypoplastrals meet on midline	120	136	160 ^e
Xiphiplastrals meet on midline	80	95	100
Gulars meet on midline	57	68	—
Humeral meet on midline	40	47	—
Pectorals meet on midline	73	90	—
Abdominals meet on midline	115	110	—
Femorals meet on midline	70	82	—
Anal meet on midline	52	65	—

^e, estimated.

8. *Echmatemys douglassi* sp. nov.

Plate XXII; text-figs. 11 and 12.

Type: C. M. No. 3244, consisting of a somewhat damaged carapace with a complete plastron. The carapace lacks portions of the peripheral borders of the front and sides in addition to several small areas out of the costal and neural regions. Collected by Earl Douglass, May 25, 1908.

Locality: South Branch of Red Bluff Wash, above the well on the road between Bonanza and Kennedy's Hole, Uinta Basin, Uinta County, Utah.

Horizon: Lower portion Horizon B, "Transition Beds" (Peterson), "in sandstone same as No. 28,"⁷ Uinta formation, Upper Eocene.

The carapace, although crushed over toward the left side, shows the shell to be elongated with the median portion high and vaulted. The surface of the shell is smooth. The peripherals behind the inguinal notches are moderately thin with acute edges and with a tendency to flare upward. The sulci are narrow, but

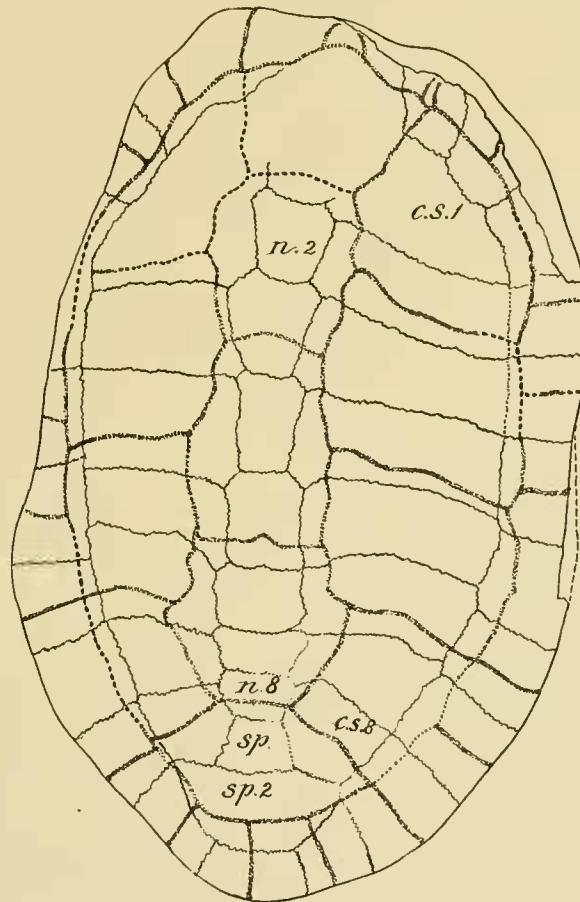


FIG. 11. *Echmatemys douglassi*. Carapace of the type, C. M. No. 3244. One-fourth natural size. *c.s. 1*, *c.s. 8*, costals one and eight; *n. 2*, *n. 8*, neurals two and eight; *sp.*, suprapygal; *sp. 2*, second suprapygal.

deeply impressed. The total length of the carapace in a straight line is about 470 mm. Its width is 300 mm., its height at the center is about 186 mm.

The nuchal scute is wedge-shaped with the narrow end forward. Some of the anterior margin of this bone is missing so its length cannot be given. The posterior end has a greatest width of 22 mm.

⁷ No. 28 is C. M. catalog No. 3270 and is identified as *Echmatemys uintensis* Hay.

The first neural is represented by the posterior end only, the second to the sixth inclusive are complete, the seventh and eight are only partially preserved. In general the neurals are hexagonal with their broadest ends forward. The anterior ends of the second to the fifth are concave. There is no indication of a carina on any of the neurals. Their principal dimensions are given in the table below:

No.	Length.	Width.
2.....	40.....	45.....
3.....	45.....	42.....
4.....	48.....	35.....
5.....	47.....	41.....
6.....	32.....	44.....
7.....	24.....	44e.....
8.....	29.....	—.....

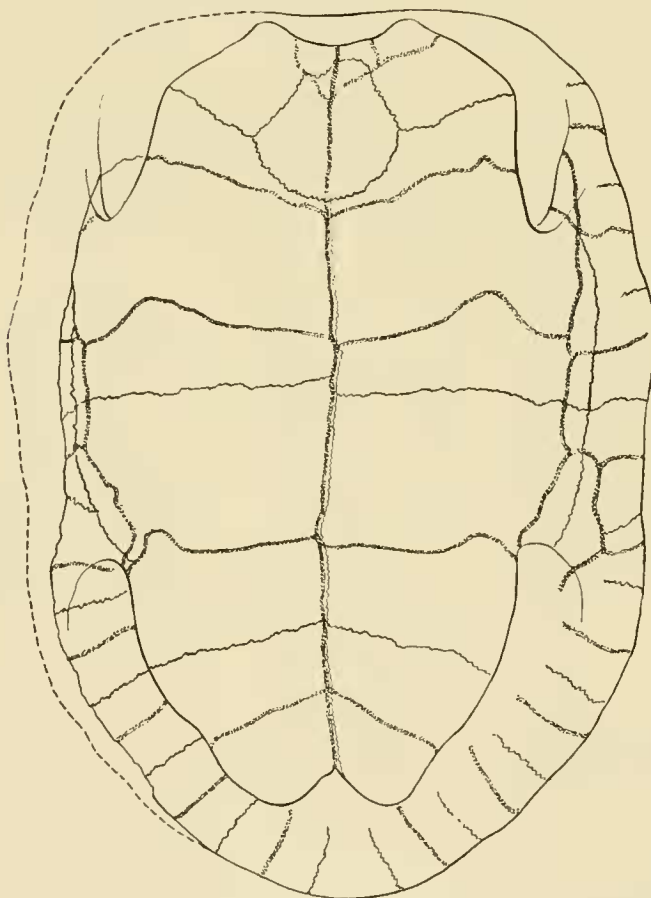


FIG. 12. *Echmatemys douglassi*. Plastron of type, C. M. No. 3244. One-fourth natural size.

There are as usual eight costals. These vary but little in the width of their proximal and distal ends. The fifth on the right side has a length of 144 mm.; the first at the suture with the second a length of 123 mm.

The peripherals are high. On the right side immediately posterior to the inguinal notch they extend upward 74 mm. above the margin of the shell; the most posterior one 45 mm.; the most anterior one 56 mm. above the margin.

The suprapygal is 41 mm. long. The second suprapygal is 52 mm. long, and 93 mm. across the middle, and 42 mm. where it joins the pygal. The pygal has a length of 32 mm., a width of 55 mm. The posterior boundary of the fifth vertebral crosses the second suprapygal 20 mm. anterior to its posterior margin. Both the pygal and second suprapygal are strongly arched above the tail.

The vertebral scutes are long. The sides of the median three are slightly bracket-shaped, the fourth, as in *Echmatemys uintensis* Hay, is strongly urn-shaped. The dimensions of the vertebrae are given in the accompanying table.

DIMENSIONS OF VERTEBRALS.

No.	Length.	Width in Front.	Greatest Width.
1	80 ^e	97	97
2	93	—	77 ^e
3	98	53	69
4	90	66	92
5	63	—	117

^e, estimated.

There appear to be twelve marginals in the complete series of one side, and some rise to the proximal ends of the peripherals. On the right side the eighth peripheral is crossed by the marginal sulcus 21 mm. below the costo-peripheral suture. The most posterior marginal scute is 53 mm. high from the margin of the shell.

The plastron is perfectly preserved and characters observed in the plastron show the distinctness of *Echmatemys douglassi* from all other described forms. The plastron has a maximum length of 407 mm. At the center it measures 374 mm. in length. The front of the anterior lobe is broadly and deeply emarginated, the emargination lying between two toothed projections which extend forward at either side, as is well shown in Fig. 12. On account of this emargination there is no well-defined lip. The anterior lobe is broad and at its base measures 190 mm. with a length at the center of 95 mm. The length therefore is exactly 50 per cent. of the width. The lateral borders of the lobe in front of the axillary notches are slightly concave, then expanding a little to the posterior ends of the epiplastra, then turning inward to the toothed projections at either side of the lip. The latter is wide, measuring 94 mm., which is nearly one-half of the total width of the lobe.

The posterior lobe has a greatest length at the center of 130 mm.; a width at the base of about 199 mm. The hinder lobe is considerably constricted at the anal-

femoral sulcus, and from this point posteriorly the lateral borders converge quite rapidly to the posterior end, which is deeply notched. The great breadth of the lobes in *E. douglassi* leaves but little space for the exit of the limbs, and in front the exit is still further closed by the upward curve of the anterior lobe as in *E. callopyge* Hay. Transversely the plastron is angularly concave, but how much of this depression may be attributed to *postmortem* causes it is impossible to determine. It may be largely sexual, and in that case this specimen would represent a male.

The entoplastron is pear-shaped and extends forward to within 11 mm. of the anterior margin of the lobe, a most unusual position in the Emydidae. The length of the entoplastron is 79 mm.; its width 71 mm. The bridge has a width of 167 mm. In this specimen, as shown in Fig. 12, there are intergular scutes, which overlap the entoplastron. On the left side the gular-humeral sulcus follows the usual course, reaching the margin of the lobe immediately posterior to the toothed projection marking the external boundary of the lip. On the right side, however, there is no trace of this sulcus. Intergulars are not known in any other member of the Emydidae, and it may be that the scutes here designated as intergulars are the gulars, and that the extra scute on the left side is supernumerary. Even should that be the case, the position of the sulcus crossing the border on the mesiad side of the toothed projection is unusual, and probably constitutes an individual variation, the true condition of which can only be cleared up by the discovery of additional specimens pertaining to this species.

The pectorals do not reach the entoplastron, but at the center pass 6 mm. behind it. They have their greatest width of 60 mm. at the center. The humerals meet along the midline for a distance of 65 mm.; the abdominals for 98 mm.; the femorals for 68 mm.; and the anals for 55 mm.

The hyoplastrals are 85 mm. wide antero-posteriorly at the midline, the left being slightly more. Each extends laterally about 132 mm. The hypoplastrals meet on the midline for a distance of 122 mm.; the xiphoplastrals for a distance of 83 mm. The notch between their hinder ends is 20 mm. deep, with a greatest width of 50 mm.

In the general shape and contour of the shell this species closely resembles *Echmatemys stevensoniana* (Leidy), from the Bridger beds of Wyoming. It differs from that species, however, in the deep emargination of the anterior lobe and the failure of the pectoral scutes to reach the entoplastron.

Echmatemys douglassi is distinguished from all described species of the genus by the deep emargination of the anterior median border of the anterior lobe; by the short and wide anterior lobe, the length of which at the center is only fifty per cent.

of the width at the base, and by the close proximity of the anterior end of the entoplastron to the border of the lip. In the unusual proportions of the anterior lobe it most nearly resembles *E. arethusa* Hay from the Bridger beds, but is at once distinguished from it by the concave lip, as contrasted with the projecting lip of the former species. In having the humero-pectoral sulcus pass behind the entoplastron this species is distinguished from all other species of the genus with the exception of *E. lativertebralis* (Cope), *E. megaulax* (Cope), and *E. rivalis* Hay.

This species is dedicated to Mr. Earl Douglass, who collected the type specimen, as well as the greater number of specimens comprised in this collection of turtles.

9. *Echmatemys hollandi* sp. nov.

Plate XXIII, fig. 1; text-fig. 13.

Type: C. M. No. 3249, consisting of a considerable portion of the carapace, lacking the posterior and the greater part of the peripherals and costals of the left side and the outer halves of most of the remaining peripheral and marginal

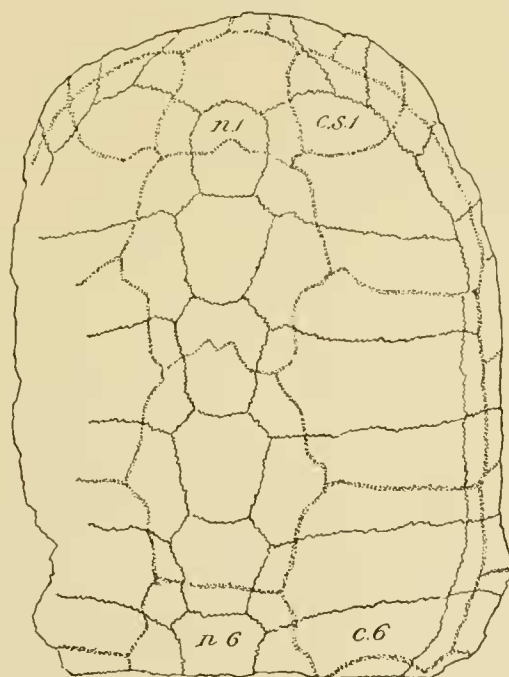


FIG. 13. *Echmatemys hollandi*. Carapace of the type, C. M. No. 3249. One-third natural size. *c. 6*, sixth costal; *c.s. 1*, supernumerary or first costal scute; *n. 1*, *n. 6*, first and sixth neurals.

bones. A considerable part of the plastron is present but the under surface is so badly shattered that nearly all traces of the sutures and sulci have been obliterated. The impression remaining in the matrix, however, gives some idea of the shape and dimensions of the anterior and posterior lobes. Collected by Earl Douglass, 1908.

Locality: Skull Butte, southwest of Well No. 2, Uinta Basin, Uinta County, Utah.

Horizon: Horizon B, Uinta formation, Upper Eocene.

The carapace is elongated oval being more broadly rounded in front than *Echmatemys callopyge* Hay. The median portion is high and vaulted. The length of the carapace is estimated to have been about 360 mm.; its width about 260 mm. The height at the center is 133 mm. The surface of the shell is smooth. The sulci are narrow, but well impressed.

The nuchal plate has the anterior border missing, so that its greatest length cannot be determined. It has a greatest width of 82 mm., and where the lateral sutures cross the costo-marginal sulcus it is 57 mm. wide.

The neurals back of the first are all hexagonal with the anterior ends concave. Those preserved are all longer than broad. On either side of the anterior end of the first neural are hollowed out depressions which give this bone the appearance of being bluntly ridged anteriorly, but otherwise there is no indication of carinae.

No.	Dimensions of Neurals.		No.	Dimensions of Vertebral Scutes.		
	Length.	Width.		Length.	Width in Front.	Greatest Width.
1	45	30	1	65	46	55
2	40	36	2	80	50	77
3	41	35	3	87	40	72
4	38	35	4	—	49	73
5	38	36				
6	—	36				

The peripherals appear to have been high, but on account of the damaged condition of the borders it is not possible to give their extent.

Six costals are present in this specimen, the first having a greatest antero-posterior diameter of 63 mm.; a greatest length of 96 mm. On the upper anterior half of the first costal there is a low, rounded, obtuse elevation or horn-like projection, which at once distinguishes this species from all other described forms. The other costals show nothing unusual. The third has a greatest length of 106 mm. The costo-peripheral suture between the third and fourth passes about 17 mm. mesiad of the costo-marginal sulcus.

The first vertebral scute is unusually narrow, in this respect resembling *E. callopyge* Hay. The sides of those posterior to the first are strongly urn-shaped. The anterior end of the third is especially narrow and pointed, and extends well forward into the second. The dimensions of the vertebrae are given in the table. On either side of the first vertebral are supernumerary costal scutes, and it is largely within their boundaries that the horn-like elevations, described above, arise.

The area of the first costal scute is much reduced, but it is still in contact with the first vertebral. Supernumerary costals are not unusual in the Baënidæ, though I am not aware of their having been found before in the genus *Echmatemys*. When present, they are usually confined to one side, seldom are they symmetrically paired as in the present specimen.

The plastron is exceedingly thick and heavy. At the center it measures 30 mm. in thickness. Though much of the anterior and posterior lobes are missing the impressions remaining in the matrix show the plastron to have had a greatest length of about 315 mm.

The entoplastron though only partially preserved, has a greatest width of 50 mm. Its length cannot be determined.

The bridge has a width of about 145 mm.

There is no suggestion of a notch in the posterior lobe, shown by the impression in the matrix, but it is not possible to state positively that such did not exist. Judging from the impression left by the anterior lobe the lip was thick and broad, with an abrupt depression on the dorsal surface some 35 mm. posterior to the anterior border. The anterior end of this lobe was probably within the forward end of the carapace.

The pair of horn-like protuberances on the front of the carapace, the presence of a pair of supernumerary costal scutes on either side of the first vertebral serve to distinguish this specimen from all other described species of the genus, and I therefore take great pleasure in naming it *Echmatemys hollandi* for Dr. William J. Holland, Director of the Carnegie Museum, in recognition of his activities in the field of vertebrate paleontology.

10. *Echmatemys obscura* sp. nov.

Plate XXIV; text-figs. 14 and 15.

Type: C. M. No. 3252, consisting of a carapace, lacking the posterior end back of the sixth neural; and the plastron, lacking the lip and a small portion of the extremity of the posterior lobe. Collected by Earl Douglass, August 17, 1908.

Locality: Devil's Play Ground, south of Kennedy's Hole, Uinta Basin, Uinta County, Utah.

Horizon: Horizon C, "gray beds below red and gray beds," Uinta formation, Upper Eocene.

Except for the parts missing from the posterior end of the carapace, the type specimen is well preserved and all of the sutures and sulci are clearly displayed. The carapace is broadly rounded in front with a wide, but shallow, emargination of

the nuchal border. The median portion is high and vaulted. The length of the carapace is estimated to have been about 390 mm., its breadth is 286 mm., its height at the center is 130 mm. The plastron is broad, and, like many other species of the genus *Echmatemys*, there is but little space in front of the axillary notches for the exit of the limbs. The margins of the carapace forward of the axillary notches are thickened and rounded, but forward it thins rapidly, coming to an obtuse edge along the median anterior border. The peripherals of this region do not flare upward, though those immediately posterior to the inguinal notches show a tendency to do so.

The carapace is smooth, except that the median costal areas are crossed antero-posteriorly by a series of wide, parallel, wavy, flattened ridges. In a line 12 mm. long three of these ridges may be counted. This ornamentation is inconspicuous unless the light strikes the surfaces at the proper angle. It is the obscure nature of this ornamentation which has suggested the specific name.

The nuchal plate is unusually long and narrow. At the point of its greatest transverse diameter the sides are considerably within the boundaries of the first vertebral. The length of the nuchal is 65 mm.; its greatest transverse diameter is 51 mm.; the free border measures 40 mm. The nuchal surface is without median elevation. *Echmatemys obscura* is the only species of the genus which has the nuchal plate longer than wide.

All of the neurals posterior to the first are broadly hexagonal, and all posterior to the first are broader than long. The second and third have the anterior end concave, those posterior being straight. Their principal measurements are given in the accompanying table.

DIMENSIONS OF NEURALS.

No.	Length.	Width.
1.....	47.....	35
2.....	38.....	40
3.....	43.....	43 ^e
4.....	39.....	47
5.....	31.....	41
6.....	—.....	44

^e, estimated.

The costals posterior to the first alternate in having the distal ends slightly wider and narrower than the proximal ends.

The peripherals are moderately high, the first extending inward from the border 50 mm., the seventh 58 mm.; the eighth 55 mm. The border above the bridge is heavy and rounded, but posterior to the inguinal and anterior to the

axillary notches the borders thin rapidly toward the center. The costoperipheral sutures pass along the median sides of the shell on an average of about 17 mm. mesiad of the marginal sulcus. Beyond the bridges the sutures and sulci in some

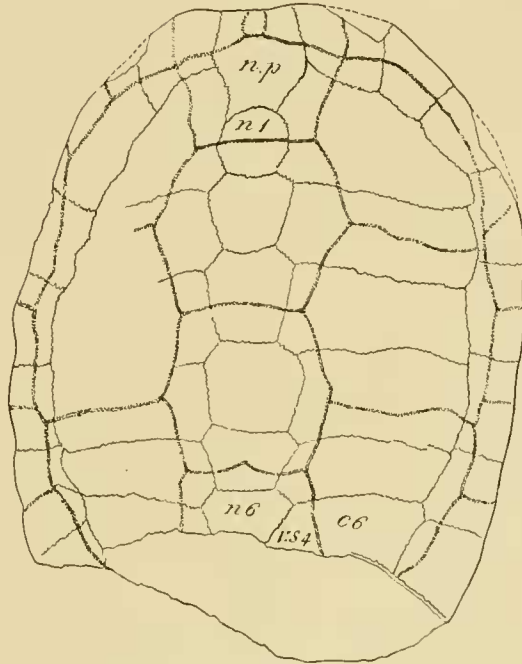


FIG. 14. *Echmatemys obscura*. Carapace of type, C. M. No. 3252. One-fourth natural size. *n. 1*, *n. 6*, neurals one and six; *n.p.*, nuchal plate; *v.s. 4*, fourth vertebral scute; *c. 6*, sixth costal.

places approach one another as close as 4 mm., and in other places are distant as much as 30 mm.

The nuchal scute is narrow, measuring 8 mm. on the free border. It is 15 mm. long antero-posteriorly.

The vertebral scutes are wider than long, the second being especially wide. The sides of those back of the first are bracket-shaped. Their dimensions are given in the accompanying table.

DIMENSIONS OF VERTEBRALS.

No.	Length.	Width in Front.	Greatest Width.
1	75	87	87
2	83	58	102
3	79	60	81
4	—	58	—

The costo-marginal sulci run below the costo-peripheral sutures. The sulci on both carapace and plastron are narrow and moderately impressed.

The plastron in life had a length of about 372 mm. The posterior end is

narrow, but deeply notched. The length of the anterior lobe is about 100 mm.; its width at the base is about 162 mm. The length is therefore only 61 per cent. of the width. From the axillary notch the free border runs straight forward for a short distance then curves in regularly to the epiplastral lip, which is missing in

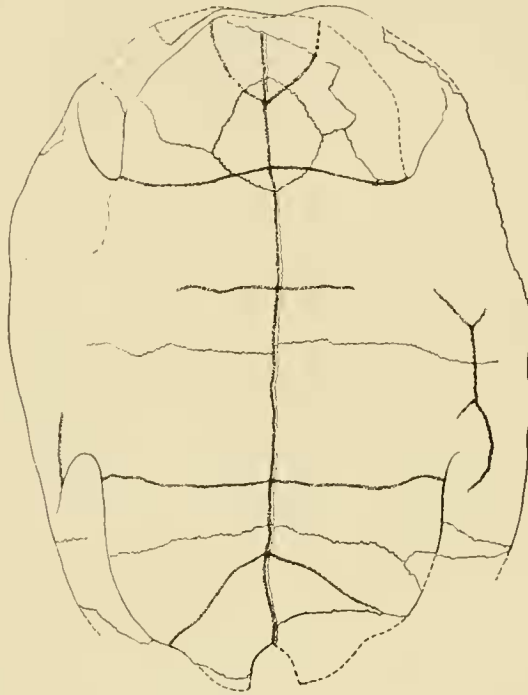


FIG. 15. *Echmatemys obscura*. Type, C. M. No. 3252. Plastron. One-fourth natural size.

this specimen. This free border is relatively thin and acute, thickening somewhat as it approaches the lip. The lip appears to have been about 50 mm. wide.

The entoplastron has a length of about 60 mm. and a width of 55 mm. It is crossed by the humero-pectoral sulcus, and is also overlapped by the gular scutes. It is pear-shaped in outline, in this respect resembling the entoplastron of *Echmatemys douglassi*. The bridge is 150 mm. in width.

The length of the posterior lobe is 120 mm. Its width at the base is 191 mm. The length is therefore 62 per cent. of the width. The free borders are slightly contracted at the femoral-abdominal sulcus, and again at the femoral-anal sulcus; from which point the border turns in rapidly toward the center. The posterior lobe is terminated posteriorly by rather sharp projecting points on either side of the narrow, but rather deep, median notch. It is estimated that the notch had a depth of 30 mm. The posterior borders of the lobe are acute. At the center of the notch the bone has a thickness of 5 mm.

The anterior lobe curves upward toward the carapace much as in *Echmatemys*

septaria. The plastron is flat, but in an uncrushed specimen the bridges would doubtless curve upward to the margin of the shell. In this specimen they are but little above the level of the plastron.

The hyoplastrals meet on the midline for a distance of 80 mm.; the hypoplastrals for 97 mm.; the xiphiplastrals for 66 mm.

The gular scutes along the midline are about 52 mm. long; the humerals 37 mm.; the pectorals 63 mm.; the abdominals 101 mm.; the femorals 48 mm.; and the anals 53 mm.

Echmatemys obscura is distinguished from all species of the genus, in which the nuchal region is known, by the extreme narrowness of the nuchal plate, it being the only species known, in which the nuchal plate is longer than wide. From *Echmatemys cibollensis*, *E. megaulax*, and *E. euthneta* (the nuchal region of all three being unknown) the present species is distinguished: from the former by having the gulars overlapping the entoplastron; and from the latter two by having the gular-humeral sulcus crossing the rear portion of the entoplastron. This species is further distinguished by the greater relative widths of the neurals and especially the vertebrae. The obscure, but characteristic, ornamentation of the costal region of the carapace will also aid in recognizing this species.

11. *Echmatemys depressa* sp. nov.

Plate XXIII, fig. 2; text-fig. 16.

Type: C. M. No 2936, consisting of the carapace, lacking much of the anterior margin, the peripherals, and outer halves of the costals of the left side, and most of the peripherals posterior to the inguinal notch of the right side. The plastron is represented by a few fragments only, though the impression in the matrix gives some idea of its proportions. Collected by O. A. Peterson, August 5, 1912.

Locality: Six miles east of Myton, Uinta County, Utah.

Horizon: Horizon C, Uinta formation, Upper Eocene.

Although the open sutures of the type specimen give evidence of the immaturity of the individual, it appears to represent one of the smaller species of the genus *Echmatemys*. I was first inclined to regard it as referable to the genus *Palæotheca* on account of its small size and the presence of a dorsal keel, but a comparison with the types of the two species pertaining to that genus (*Palæotheca terrestris* Cope, and *P. polycypha* Cope) both of which are in the U. S. National Museum, shows differences which lead me to believe that it can with greater propriety be referred to the genus *Echmatemys*. The apparent absence of a second suprapygal and the extremely wide vertebrae may with other characters to be observed in a more perfect specimen show its distinctness from that genus.

In a straight line the shell has a greatest estimated length of 135 mm.; at the center a greatest width of 115 mm. Though depressed, the upper shell is broadly convex in all directions, dropping off rather more rapidly toward the back than toward the front. The upper surface of the carapace is smooth, the sulci lightly impressed, and nowhere are scutal growth lines to be observed.

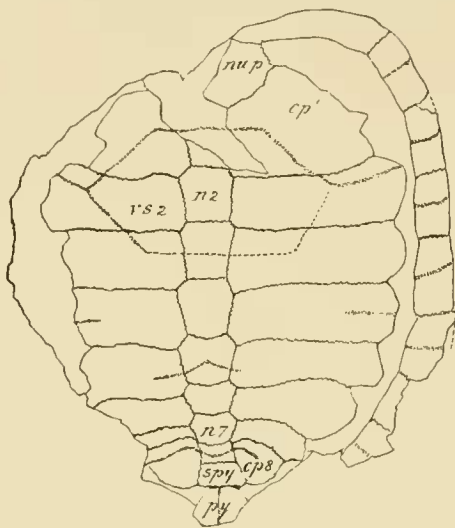


Fig. 16. Carapace of *Echmatemys depressa*. Type. C. M. No. 2936. One-half natural size. *c.p.*', *c.p.* 8, costal plates one and eight; *n. 2*, *n. 7*, neurals two and seven; *nu.p.*, portion of nuchal plate; *py.*, pygal; *sp.y.*, suprapygal; *v.s. 2*, second vertebral scute.

The nuchal is only partially preserved, but this portion shows that it had a greatest width of 26 mm. and was obtusely keeled at the center. The anterior border, as shown in Fig. 16, is missing.

There are eight neurals, all of which are hexagonal, with the exception of the first and eighth, the latter being subrectangular in outline. All have their anterolateral angles truncated, which serves at once to distinguish this form from *Echmatemys pusilla* Hay, which has the postero-lateral angles of the neurals truncated. The neurals gradually decrease in size from front to back, and, excepting the first and third, all are broader than long, as shown in the accompanying table. The second and third neurals are sharply keeled on their posterior and anterior ends respectively, as are the fourth and fifth, while the sixth, seventh and eighth are keeled their entire lengths. The keel on the suprapygal is very low and hardly discernible.

All of the costals of the right side are present and perfectly preserved. They are of moderate thickness with pointed distal ends which articulated with the peripherals by gomphosis. Portions of the buttresses preserved in the matrix indicate that they articulate with the costals considerably above the costo-peripheral suture.

DIMENSIONS OF NEURALS.

No.	Length.	Width.
1.....	17	12
2.....	13	16
3.....	14.5.....	14
4.....	13.5.....	14
5.....	13.5.....	14
6.....	11	14
7.....	10	12
8.....	9	10

The peripherals of the right side above the bridge and somewhat forward of the axillary notch are perfectly preserved, and, as in *Echmatemys pusilla* Hay, have a sharp carina beginning on the third peripheral and continuing backward across the bridge to the hinder peripherals. The fifth peripheral has a width of 19 mm.; the sixth of 18 mm.; the seventh of 20 mm.; the eighth of 18 mm. The lateral peripherals from the edge of the carapace to their proximal extremities have a length of 14 mm., becoming narrower toward the front of the shell.

The sulci on most parts of the carapace are very obscure, being traceable only here and there, though where they cross the neurals somewhat plainer than elsewhere. The boundaries of the second vertebral can be partially determined, and these indicate a very wide scute having at the center angularly pointed outer borders. The second vertebral has a greatest width at the center of 58 mm.; an estimated length of about 32 mm. There were four costal scutes. The costal-marginal sulcus appears to have followed closely the course of the costo-peripheral suture. The supracaudal scute is divided. The second suprapygal is absent in this specimen.

The impression in the matrix shows the hypoplastron to have a greatest width at the midline of 41 mm. The width of the posterior lobe at the base is about 60 mm. Its greatest length was about 47 mm. It cannot be determined whether this lobe was notched on the midline. At the center the plastron has a greatest width of 84 mm. The bridge has a width of about 58 mm. The inguinal buttresses rise well above the costo-peripheral sutures and articulate with both the fifth and sixth costals.

Echmatemys depressa is distinguished from all other species of the genus by the greater relative widths of the vertebral scutes, the absence of a second suprapygal, and the presence of a dorsal keel. From *Echmatemys megaulax* (Cope), which also has a dorsal keel the present species is to be distinguished by having the sulci less deeply impressed and in having the costo-marginal sulcus follow the

course of the costo-peripheral suture whereas in the former it crosses the peripherals on their upper third.

12. *Echmatemys pusilla?* Hay.

Echmatemys pusilla HAY, Fossil Turtles of North America, 1908, pp. 337-339, text-figs. 445, 446.

A small turtle, C. M. No. 3282, collected by Messrs. Earl Douglass and Clarence Wilson, November 1, 1911, southeast of Ouray, Uinta County, Utah, from Horizon C of the Uinta formation, Upper Eocene, is referred with some doubt to *Echmatemys pusilla* Hay. The very fragmentary nature of the present specimen renders its generic and specific affinities difficult of positive determination, but after a careful comparison of this specimen with the type of *E. pusilla*, kindly loaned me by Dr. W. D. Matthew, of the American Museum of Natural History, I am convinced of the very close relationships of the two specimens, even though the discovery of more perfect material may eventually demonstrate their specific distinctness.

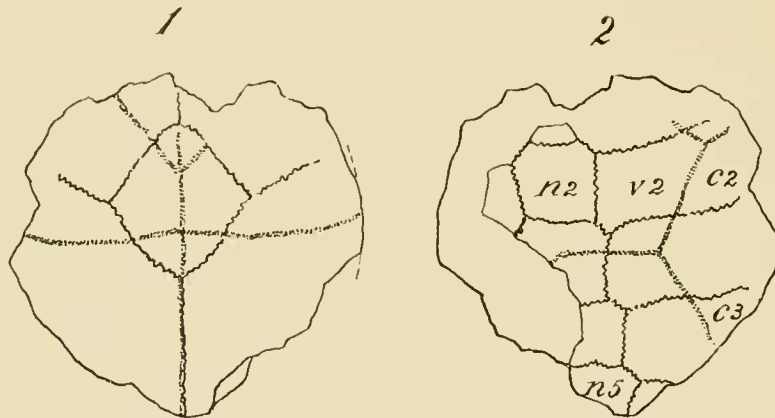


FIG. 17. Portions of the carapace and plastron of *Echmatemys pusilla?* Hay. C. M. No. 3282. (1), plastron; (2), carapace. *c2*, *c3*, costals two and four; *n2*, *n5*, neurals two and five; *v2*, vertebral scute two. Natural size.

This specimen consists of the anterior lobe of the plastron lacking the lip, a small portion of the carapace consisting of the second neural complete, and portions of the third, fourth, and fifth neurals with the upper portions of abutting costals, as shown in Fig. 17. The second neural is hexagonal in outline and measures 9.5 mm. in length, with a greatest width of 10 mm.; the third is 12 mm. long and 13 mm. wide; the fourth is 13 mm. long. The second vertebral has its greatest width of about 35 mm. at the center. The scutal areas of the carapace are plainly grooved by the lines of growth of the scutes. These lines of growth are also present in the type of the species.

The entoplastron, as in the type, is long, narrow, and pointed in front. Its greatest length is 19 mm., its greatest width 16 mm. It is overlapped by both the gulars and pectorals. The specimen before me also agrees with the type in the great width of the pectorals behind the entoplastron. These scutes reach backward to the hypoplastral suture, a condition not known in any other species of the genus. At the point where the pectoro-humeral sulcus crosses the free borders the lobe has a width of 48 mm. The free border of the lobe is thin and acute, being bevelled off on the upper surface.

The most important dissimilarity between the two specimens here discussed appears to be in the wide vertebrals and in the shape of the neurals, those of the type having the postero-lateral angles truncated, whereas in the specimen from the Uinta formation the antero-lateral angles of the third, fourth, and fifth are thus cut off. The second neural is octagonal in the type, hexagonal in No. 3282. In the shape of the anterior lobe of the plastron, the long pointed entoplastron overlapped by the gulars and crossed well forward by the pectoro-humeral sulcus and the extremely wide pectorals reaching backward nearly to the hyo-hypoplastral suture these specimens show a remarkably close resemblance.

Family TESTUDINIDÆ Gray.

The family Testudinidæ is represented in the collection of chelonian remains from the Uinta formation in the Carnegie Museum by the two genera *Hadrianus* Cope and *Testudo* Linnæus. the former genus by three, the latter by but one species. Four species of *Hadrianus* are now recognized as occurring in the Uinta formation. The discovery of *Testudo* in the Upper Eocene is of interest as being the first time this genus has been found below the Oligocene in North America. In the Fayum deposits (Upper Eocene) of northern Africa, however, the genus *Testudo* has been recognized by Andrews from well-preserved specimens, which in several respects closely resemble the species here described.

Genus HADRIANUS Cope.

13. *Hadrianus corsoni* (Leidy).

Plate XXV, fig. 1; text-fig. 18.

Testudo corsoni LEIDY, Proc. Acad. Nat. Sci. Phila., 1871, p. 154; Contrib. Extinct Vert. Fauna West. Terrs., 1873, pp. 132, 339, Pl. XI, figs. 1, 2; Pl. XV, fig. 7; Pl. XXIX, figs. 2-4; Pl. XXX, figs. 1-4.

Hadrianus octonarius COPE, Palæont. Bull. No. 2, 1872; Vert. Tert. Form. West., 1884, p. 140, Pl. XX, figs. 1-4.

Hadrianus corsoni COPE, U. S. Geol. Surv. Terrs., 6th Ann. Rept., 1872 (1873), p. 631; HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 450; Fossil Turtles of North America, 1908, pp. 376-380, Pl. LX, LXI; text-figs. 473-479.

A large specimen in the present collection is identified as belonging to the above genus and species, and represents the first recorded occurrence of *Hadrianus corsoni* in the Uinta formation. This specimen consists of a complete plastron, the peripherals of the right side above the bridge, and a few fragments of the carapace. It was collected by O. A. Peterson, August 5, 1912, six miles east of Myton, Uinta County, Utah, from Horizon C of the Uinta formation, Upper Eocene. It bears the C. M. Catalog No. 3403.

The length of the plastron at the center is 740 mm.; the greatest length over all 775 mm.; the greatest breadth about 490 mm. The posterior lobe is deeply and widely notched and the anterior lobe is terminated in front by a wide spade-like lip which projects prominently from the general contour of the lobe.

Hadrianus corsoni was based upon the anterior portion of a plastron consisting of the complete lip and lobe back to and including a small portion of the anterior end of the entoplastron. A comparison of the specimen before me with the type shows striking similarities in the contour of the lobe and lip, and especially of the wide anterior end of the entoplastron, which appears peculiar to this species. The lip has a transverse width at the base of 162 mm., which is greater than that of the type, or of any subsequently discovered representative of this species. It projects 45 mm. beyond the point where the gular-humeral sulcus crosses the free border. This measurement is slightly greater than in the type, but less than in the type of *Hadrianus octonarius* Cope, now regarded by Hay as being a synonym of the present species. The anterior border of the lip is subacute, nearly straight, but slightly notched on the midline as in the type. The upper surface of the lip is slightly convex along the midline, with shallow longitudinal depressions on either side. The lower surface is flat, but I am inclined to believe it would have been broadly convex in life.

The anterior lobe is 345 mm. wide at the base, with a length of 252 mm. Along the free borders on the upper surface the bone is bevelled off to an acute edge that becomes obtusely rounded in front of the axillary notches. The lip on the superior surface extends backward 67 mm.

The entoplastron is unusually broad and angular in front. In the figures of the type the suture limiting the anterior border of the entoplastron runs nearly straight across the median line, then turns abruptly backward and outward. In the specimen here considered the anterior border is inclined more posteriorly, as

in the type of *H. octonarius*, but it has the same angular turn backward and outward as in the type of the genus and species. The length of the entoplastron on the

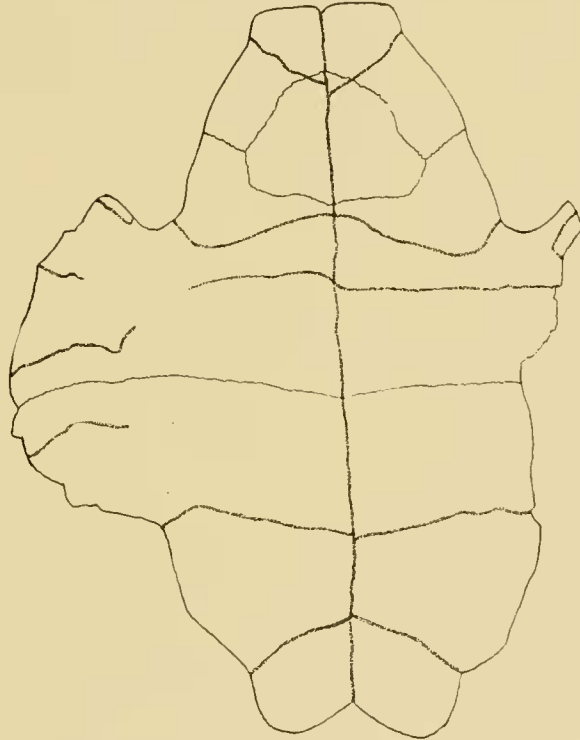


FIG. 18. *Hodrianus corsoni* (Leidy). Plastron of C. M. No. 3403. One-eighth natural size.

midline is 155 mm.; its width 184 mm. It is overlapped slightly by the gular scutes, but is not crossed by the humero-pectoral sulcus.

The bridge is 290 mm. wide.

The length of the posterior lobe is 234 mm.; its width at the inguinal notches 386 mm. The free edges of the lobe are subacute, except in front of the notches, where it is rounded. The width of the posterior notch is about 135 mm.; its depth about 35 mm. There is no perceptible ridge leading back from the inguinal buttresses until a point midway between the buttress and the posterior end of the lobe is reached, where the surface is concave mesiad, thus causing the ridge to stand out quite prominently. On the outside of this ridge the surface is bevelled off steeply near the buttress, but less and less so posteriorly, until on the posterior outer angle of the xiphiplastral projections the slope is very gentle. The surfaces of these projections are rugosely roughened as in the type of *H. octonarius* (No. 2186, U. S. National Museum), which they resemble in shape and size.

The hyoplastron on the midline has a width of 195 mm. The arrangement of

the plastral scutes is not greatly different from that of other Testudinidæ. The gulars have a length on the midline of 90 mm.; pectorals of 60 mm.; abdominals of 255 mm.; femorals of 95 mm.; anals of 86 mm. The principal dimensions and proportions of specimen C. M. No. 3403, as compared with other specimens identified as pertaining to *Hadrianus corsoni* Leidy, are given in the table below.

	C. M. No. 3403.	<i>Hadrianus corsoni</i> A. M. N. H. No. 6027.	Type of <i>H. octonarius</i> U. S. N. M. No. 2186.
Greatest length of plastron	778	550	740
Greatest length anterior lobe	252	175	247
Greatest width anterior lobe	345	246	360
Width of bridge	290	215	285
Greatest length posterior lobe	234	157	240
Greatest width posterior lobe	386	240	330
Length of entoplastron	155	115	125
Width of entoplastron	184	134	160
Width of lip	162	118	135
Width of bridge to width of anterior lobe	81%	87%	79%
Width of anterior lobe to its length	72%	71%	68%
Width of bridge to length of posterior lobe	80%	73%	84%

14. *Hadrianus robustus* sp. nov.

Plate XXV, fig. 2; text-fig. 19.

Type: C. M. No. 3342, consisting of the anterior half of the plastron, collected by Earl Douglass, July 30, 1908.

Locality: Near Kennedy's Hole, Uinta Basin, Uinta County, Utah.

Horizon: Horizon C, Uinta formation, Upper Eocene.

The specimen upon which the present species is based represents one of the larger species of the genus. Those parts present are in a good state of preservation, and all of the sutures and sulci can be clearly traced. It is assigned provisionally to the genus *Hadrianus*, until such time as the discovery of a more perfect specimen makes it possible to determine its true generic affinities.

The anterior lobe is 220 mm. long, and at the base 285 mm. wide. The length thus being 77 per cent. of the width, whereas in *Hadrianus corsoni* it is only 71 and in *H. majusculus* 68 per cent. The lip in this species is especially prominent and exceedingly heavy, having a thickness at the center of 46 mm. At the base it measures 123 mm. in width, and near the anterior end 117 mm. From the point where the gular-humeral sulcus crosses the free border the lip extends forward 52 mm. The anterior border of the lip is transversely broadly convex, and bluntly bevelled dorso-ventrally, the longer bevel being on the lower side. On the superior surface the lip extends posteriorly 100 mm., at this point the surface descends perpendicularly, decreasing by one-half the total thickness of the plastron. Slightly

posterior to this drop on the visceral surface there is a sharp median ridge on the midline which measures longitudinally 65 mm. The free borders of the anterior lobe are bevelled off from the superior surface to a sharp edge, which becomes obtusely rounded at the base of the lip.

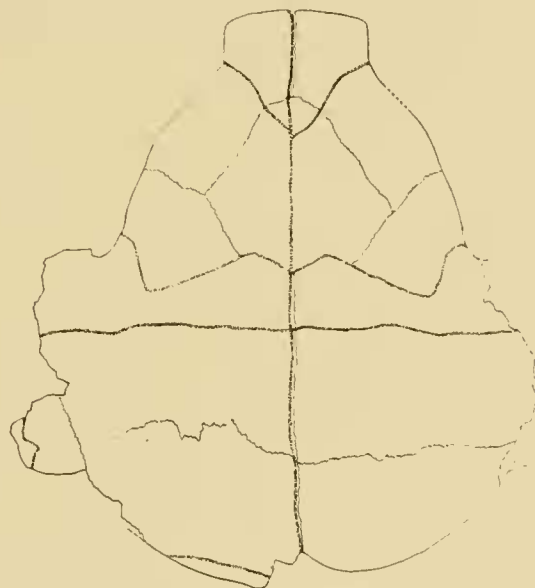


FIG. 19. *Hadrianus robustus*. Anterior half of the plastron. Type, C. M. No. 3342. One-sixth natural size.

The entoplastron is pointed in front and wide behind. It is 134 mm. long, and 147 mm. wide. The gular scutes overlap the anterior end.

In front of the axillary notch the plastron has a thickness of 29 mm.; immediately posterior to the entoplastron of 16 mm.; and at the junction of the hypo-hyoplastron at the center, of 15 mm. This latter measurement in the type of *Hadrianus tumidus* Hay is only 9 mm. The gular scutes have their greatest extent of 114 mm. antero-posteriorly. Within the area of the gular scutes the surface of the lip is swollen out somewhat below the level of the epiplastral areas bordering it. The superior surface of the lip anteriorly is broadly convex, but flattens toward the posterior end.

The humerals meet on the midline for 105 mm.; the pectorals for 40 mm.; the abdominals for at least 205 mm. The sulci are broad and deeply impressed. The humero-pectoral sulcus begins just in front of the axillary notch and extends inward and backward for a short distance, then curves forward to the entoplastron, again turning backward to the midline, skirting, but not crossing, the entoplastron.

The pectoral scutes have quite a different shape from any of the described species of the genus. They are narrow (28 mm.) mesiad of the axillary notch

gradually widening to a point a little beyond where the sulcus first reaches the entoplastron, which measures 63 mm. antero-posteriorly, then again narrowing to the midline, where it has a fore-and-aft extent of 40 mm. The pectoro-abdominal sulcus runs straight across the plastron as in *Hadrianus corsoni*.

The hyo-hyoplastral suture runs a very tortuous course across the plastron. The hyoplastrals meet on the midline for a distance of 136 mm. The hyoplastrals at the center have a transverse width of 400 mm.

The pectoral scutes on the midline are less than one-fifth the width of the abdominals, and following Hay's analysis of the various species of the genus this proportion would be sufficient to show the specific distinctness of the present specimen. In the proportions of these scutes the present species is nearest *Hadrianus tumidus* Hay, which is also from the Uinta formation, and in which the pectoral scutes are less than one-third as wide as the abdominals at the center, but it is distinguished from that species by having a thicker plastron and by the different form of the pectoral scutes, and the greater width posteriorly of the entoplastron. From *H. majusculus* and *H. corsoni* the difference in the proportions of the length to the breadth of the anterior lobe will help to separate the present form; that is to say in *Hadrianus robustus* the length is 77 per cent. of the width at the base, while it is 68 and 71 per cent. respectively in the other two species mentioned above.

15. *Hadrianus utahensis* sp. nov.

Plate XXVI, fig. 1; text-fig. 20.

Type: C. M. No. 2343, consisting of the plastron and portions of the peripherals above the bridge on the right side. The anterior portion of the lip, and parts of the margins of both anterior and posterior lobes are missing. Collected by Earl Douglass, July 30, 1908.

Locality: South of Kennedy's Hole, Uinta Basin, Uinta County, Utah.

Horizon: Horizon B or C, Uinta formation, Upper Eocene.

The plastron of the type specimen is estimated to have had a greatest length of about 520 mm., and a greatest width at the center of 320 mm. The anterior lobe is about 175 mm. long and 300 mm. wide at the base. The width of the lip, where the gular sulci cross the free border, is 110 mm. The plastron is quite concave, indicating that the specimen was in all probability a male.

While every thing indicates that the lip extended well forward, it probably continued the general contour of the lobe. The free borders of the lobe are subacute, being bevelled off from the upper surface, so that the edge is nearly on a level with the ventral surface of the plastron. At the center on the broken border

the lip is 22 mm. thick, but posteriorly it increases to 27 mm., behind which the plastron is deeply excavated. On the upper surface of the lip there is a slight median elevation. Transversely the whole lip is broadly convex rounding down at the sides to a subacute edge.

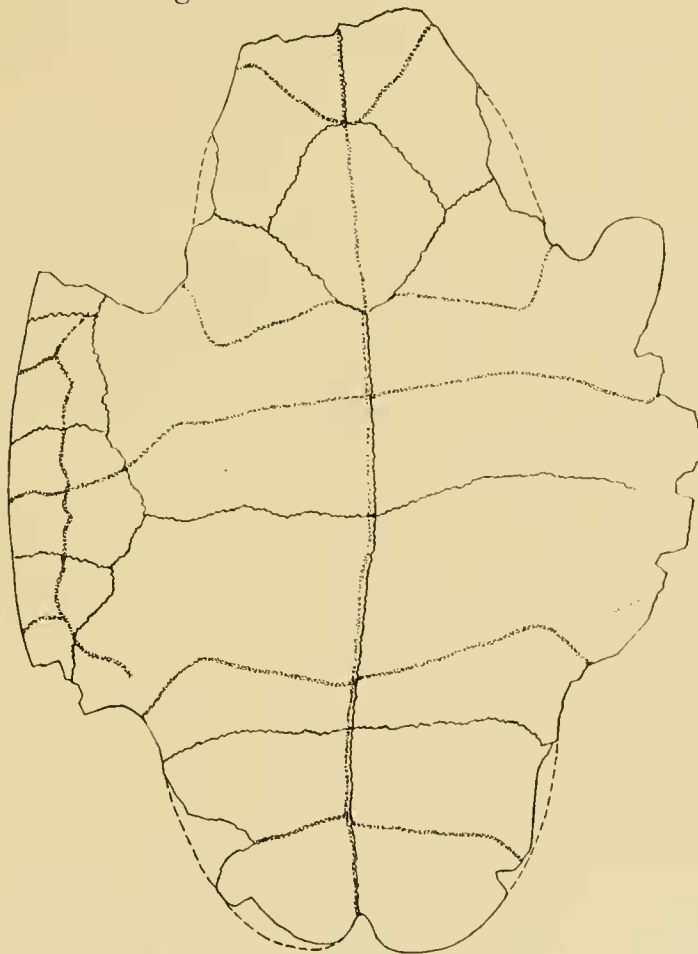


FIG. 20. Plastron of *Hadrianus utahensis*. Type. C. M. No. 2343. One-fourth natural size.

The entoplastron is rhombic in form, being 97 mm. long and 95 mm. wide. The gular scutes reach, but do not overlap, this bone. In this respect this specimen differs from all of the described species of the genus. The bridge has a greatest width of 210 mm.

The posterior lobe has a greatest length of about 140 mm.; a greatest width of 230 mm. at the inguinal notches. The posterior lobe is shallowly notched on the midline. This notch has a greatest depth of 10 mm. Immediately behind the inguinal notches the borders of the lobe have a thickness of 27 mm. and are rounded dorso-ventrally. The border at the anal sulcus is 18 mm. thick. The free border of the entire lobe a short distance posterior to the inguinal notches is bevelled off

from the dorsal surface to a subacute edge. There is no ridge leading back from the buttresses as in *H. tumidus* Hay. In front of the notch on the dorsal surface the plastron is transversely shallowly concave. The plastral buttresses are relatively heavy.

The hyoplastrals meet on the midline for a distance of 108 mm.; hypoplastrals for 120 mm.; xiphiplastrals for 107 mm.

The sulei on the plastron are relatively narrow but well impressed. The gular sulei run forward and outward from the center, but, as they approach the border, suddenly turn outward and then backward continuing in this direction over the border upon the dorsal surface and fading out at the base of the lip. The suleus limiting the humerals behind runs backward and slightly inward from the border in front of the axillary notch for a short distance, then turns inward and forward to the posterior boundary of the entoplastron, but does not cross it. The pectorals occupy 41 mm. of the midline, and have a least diameter antero-posteriorly of 29 mm. The abdominals meet on the midline for a distance of 155 mm.; the femorals for 75 mm.; anals for 58 mm. The plastron at the center has a thickness of only 7 mm.

The peripherals turn abruptly upwards at the sides of the shell. The sulei between the plastron and peripheral bones on the bridge, although broadly interdigitative, run quite a straight course antero-posteriorly. The fifth and sixth peripherals have a width of 64 mm. Their length on account of the missing upper extremities cannot be determined.

The present specimen is assigned provisionally to the genus *Hadrianus*, though later it may be found, when more perfect specimens are available, that it belongs to *Testudo*. It is distinguished from the described species of the genus by the narrow and relatively shallow notch on the posterior lobe; the rounded and thickened ends of the xiphiplastrals, and by having the bridge longer relative to the length of the hinder lobe. In *Hadrianus majusculus* the posterior lobe is 85 per cent. of the length of the bridge; in *H. tumidus* 77 per cent.; in *H. corsoni* 73 per cent.; and in the present specimen only 66 per cent.

Genus TESTUDO Linnæus.

16. *Testudo uintensis* sp. nov.

Plate XXVII; text-figs. 21 and 22.

Type: C. M. No. 2331, consisting of a carapace and plastron, the latter almost perfectly preserved, the former lacking the peripherals of the right side, and the

anterior portion of the nuchal plate. Collected by Earl Douglass and party, July 30, 1908.

Locality: South of Kennedy's Hole, and about one hundred rods west of Dragon-Vernal road, Uinta Basin, Uinta County, Utah.

Horizon: Horizon B or C, Uinta formation, Upper Eocene.

In form the carapace of this tortoise is broad, of moderate height and strongly arched in all directions. As now preserved the shell is somewhat more flattened than it would have been in life. The posterior end is not so broad as in *Hadrianus* but is more evenly rounded as in many species of *Testudo*. The areas covered by the vertebral scutes are decidedly convex. The few anterior peripherals present suggest that the front was little, if at all, emarginated on the median line. All of the sutures remain distinct and the sulci can be clearly traced, so there can be no question raised as to their proper interpretation in the figures. The carapace has a length of about 360 mm.; a breadth of 300 mm.

The neurals and costals are highly differentiated. In this species there are only seven neurals, as in *Testudo ammon* Andrews, but whether this represents a constant character in this species or only an individual variation, as in *T. ammon*, must await the discovery of additional specimens. The first neural is especially elongated and oval; the second and sixth octagonal; the third tetragonal; the fourth, fifth, and seventh being hexagonal. All of the neurals are longer than wide, whereas in *Hadrianus*, *Styemys* and most of the species of *Testudo* the neurals are wider than long. The dimensions of the neurals and costals are given in the accompanying table.

No.	Dimensions of Neurals.		No.	Dimensions of Costals.	
	Length.	Width.		Width of Proximal End.	Width of Distal End.
1	44	23	1	44	68
2	39	30	2	28	47
3	33	25	3	43	30
4	31	29	4	30	60
5	34	28	5	37	14
6	39	32	6	21	49
7	31	24	7	20	22
			8	20	35

There are two suprapygals, the anterior being bifurcate and enclosing between its right and left limbs the lozenge-shaped second suprapygal. The first has a diameter antero-posteriorly at the center of 32 mm., a breadth of 88 mm.; the second is 30 mm. in length and 48 mm. in width.

The pygal is wedge-shaped, the narrower truncated end being posterior, the anterior end is notched for the second suprapygal. The under side is transversely

concave, the upper slightly convex in the same direction. The free edge is acute with a faint median projection, the whole forming a convex covering for the tail that apparently projected but little below the level of the carapace.

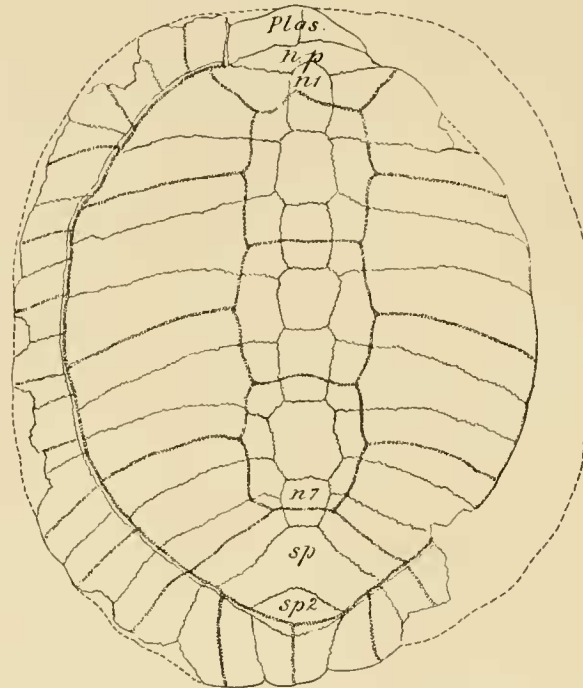


FIG. 21. *Testudo wintensis*. Carapace of the type, C. M. No. 2331. One-fourth natural size. *n.p.*, nuchal plate; *n1* and *n7*, first and seventh neurals; *plus.*, lip of plastron; *sp.*, suprapygal; *sp2.*, second suprapygal.

The costal plates are alternately wide and narrow, reaching as high a degree of differentiation in this respect as any species of the genus. The diameters of their proximal and distal ends are given in the accompanying table.

The nuchal plate is largely missing, as well as nearly all of the peripherals of the right side. Those of the left side have suffered some damage, so that their exact dimensions can not always be determined. They are however of moderate length with thin acute edges on front and back, becoming slightly obtuse along the sides. There are eleven peripherals in the complete series. The greatest thickness of the ninth peripheral, the thickest of any of the posterior members, is 16 mm. The second, measured at the suture with the first, is 16 mm. thick.

The plastron has a total length of 332 mm. The width of the anterior lobe at its base is 150 mm. It has a length of 104 mm. The lip does not extend beyond the border of the carapace, and it projects but little beyond the general contour of the lobe. The lower surface of the lobe is flat, while the upper is bevelled off from back toward the front, forming rather a sharp anterior border. On the upper

surface of the lip on either side of the low median ridge there are shallow longitudinal depressions, which run forward to the slight emarginations at either side of the center. At the gular-humeral sulcus the lateral border of the lobe is slightly emarginate. The upper surface, 57 mm. back from the front of the lip, is almost perpendicularly excavated, thus reducing the plastron from 21 mm. to 10 mm. in thickness. The posterior lobe is 90 mm. long; and is 163 mm. wide at the base. The posterior notch is 50 mm. wide and 23 mm. deep. At the inguinal notch the

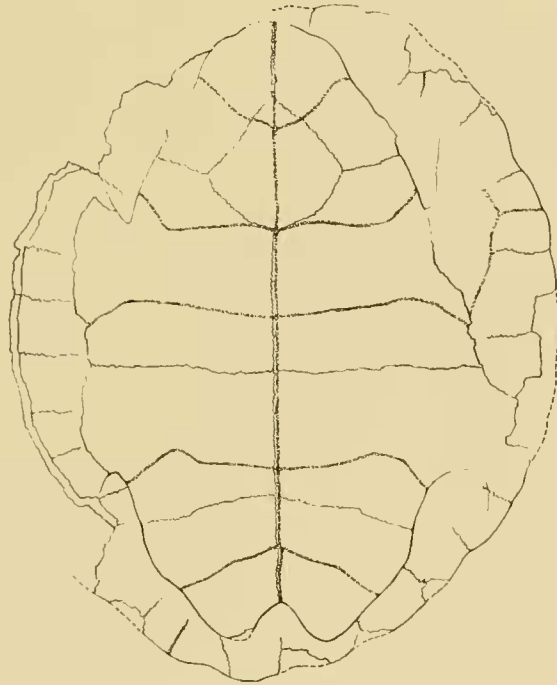


FIG. 22. *Testudo uintensis*. Plastron of type, C. M. No. 2331. One-fourth natural size.

edge of the lobe forms a wall 22 mm. high. This wall diminishes in height posteriorly, so that at the anal-femoral sulcus it measures 15 mm. in height. The outer face of this wall slopes off rather gradually to the subacute lateral edge, while the inner edge slopes abruptly to the inner level of the floor of the carapace. The entoplastron is rhombic in form, 68 mm. long on the midline, and 69 mm. wide. The hyoplastra meet along the midline for a distance of 74 mm.; the hypoplastra for 69 mm.; and the xiphiplastra for 55 mm.

The bridge is 135 mm. wide. The plastron is quite concave and at least suggests that this individual was a male.

The gular scutes overlap the entoplastron and on the midline have a length of 57 mm. The humerals at the middle are 53 mm. long; the pectorals 46 mm.; abdominals 80 mm.; femorals 42 mm.; and anals 28 mm.

The vertebral scutes are longer than wide, their dimensions are given in the table.

DIMENSIONS OF VERTEBRAL SCUTES.

No.	Length.	Width.
1.....	64.....	100
2.....	74.....	62
3.....	66.....	63
4.....	68.....	57
5.....	66.....	116

The costal scutes are wide, their outer ends joining the marginals at the costo-peripheral suture. The costo-marginal sulcus appears to follow closely the course of the costo-peripheral suture. The humero-pectoral sulcus touches the entoplastron, but does not cross it.

The supracaudal scute is divided as in *Hadrianus*.

A comparison of the type of the present species with the upper Eocene tortoise, *Testudo ammon* Andrews, from the Fayum deposits of Egypt, shows some striking resemblances. Both *Testudo uintensis* and *T. ammon* are distinguished from all other species of the genus by the octagonal shape of the second and sixth neurals, whereas the usual arrangement is for the second and fourth neurals to be octagonal. Both types agree in having seven neurals, although other specimens referred to *T. ammon* by Andrews have the normal number of eight, and it may be found that there is a similar variation in the present species.

Hay⁸ comments upon *Testudo ammon* as follows: "Dr. A.[C]E.[W] Andrews (Surv. Dept., Pub. Works Ministry, Geol. Survey, Egypt, 1903; Tert. Vert. Fayum, Egypt, 1906, p. 278, pl. 24) has described a land-tortoise from the Upper Eocene of Egypt to which he has given the name *Testudo ammon*. If a true *Testudo*, it is the oldest known. The published figures show that the neurals are variable in form, but the relationships to typical *Testudo* are so loose that it may be accepted as belonging to this genus. In some respects it appears to be intermediate between *Testudo* and *Hadrianus*."

The above remarks would apply equally well to the species here described. Up to this time the oldest known *Testudo* found in North America is from the Lower Oligocene. Two species having been described, *Testudo brontops* Marsh, and *T. exornata* Lambe.

If, as has been inferred, *Testudo* has derived its ancestry from *Hadrianus*, the intermediate characters observed in the present specimen are fully in accord with its geological position. The axillary and inguinal buttresses rising but little above

⁸ "Fossil Turtles of North America," 1908, p. 368.

the costo-peripheral suture, and the presence of a divided supracaudal scute, indicate its relationship with the genus *Hadrianus*, as now understood and defined. On the other hand, the greatly reduced heads of the ribs, and especially the high degree of differentiation reached by the neural and costal bones show its affinities to *Testudo*.

In an attempt to find characters other than those used to separate the three important genera constituting the family Testudinidæ I have determined the width of the bridge as compared to the total length of the plastron in all available specimens pertaining to the genera *Hadrianus*, *Stylemys*, and *Testudo*, and find the average to be as follows: In *Hadrianus* the bridge is thirty-eight per cent. of the length of the plastron; in *Stylemys* it is forty-nine per cent., and in *Testudo* forty-four per cent. In *Testudo uintensis* it is forty per cent. thus again demonstrating its intermediate stage of development between *Hadrianus* and *Testudo*.

Cope assigned as the principal character distinguishing *Hadrianus* from the other genera of the Testudinidæ, "a divided supracaudal scute," and this would perhaps appear a good reason for assigning the present specimen to that genus if it were not known that three living species of the genus *Testudo* as recognized by Boulenger, also have this scute divided. In the definition of the genus *Testudo* the lip is "usually projecting abruptly from the general contour of the lobe." The present specimen, however, is one of the exceptions, resembling the Oligocene *Testudo amphithorax* in this respect.

It will be seen from this brief discussion that the present means of separating the genera *Hadrianus* and *Testudo* is very unsatisfactory, and it would perhaps be best to combine them until clean cut characters are found, to show that there are two distinct genera.

Family TRIONYCHIDÆ Bell.

The soft shelled Trionychidæ are represented in the present collection by thirteen specimens of the genus *Amyda*, four of which have been identified specifically. These pertain to two species, hitherto known only from the Bridger formation. Two fragmentary specimens, C. M. Nos. 2396 and 3285, judging largely from the character of the sculpturing of the parts of the carapace present, appear to represent undescribed species, but on account of their inadequate nature I refrain from naming them. The genus *Amyda* is now represented in the Uinta formation by the following species, *Amyda crassa* Hay, *A. egregia* Hay and *A. scutumantiquum* (Cope).

Genus *AMYDA* Oken.17. *Amyda egregia* Hay.

Amyda egregia HAY, Fossil Turtles of North America, 1908, p. 531, plate 107, figs. 1-3, text-fig. 691.

A specimen (C. M. No. 3254), collected by Earl Douglass from Horizon B, of the Uinta formation, three or four miles northeast of Well 2, Uinta Basin, Utah, in 1908, is identified as belonging to *Amyda egregia* Hay. This specimen consists of the articulated nuchal, the greater portion of the first neural, the first, second, third, fourth, fifth, and sixth costals, all, excepting the first, lacking portions of their upper extremities. In the matrix on the left side are the free ends of the second, third and fourth costal ribs. These appear to be in their proper positions in relation to the other parts of the shell which are preserved, and serve to give some idea of the width and general contour of the carapace. The shell is broadly rounded in front and considerably arched transversely. The width is estimated to have been about 465 mm. The nuchal has a transverse extent of 255 mm. and measures 52 mm. antero-posteriorly. Hay states that the latter measurement in the type of the species is but 22 mm., although the figure published by him shows it to be at least 42 mm. As in the type specimen the outer end of the nuchal overlaps the free end of the rib of the first costal. The first neural at the anterior end is 40 mm. wide. The sculpture of the carapace is coarse. On the inner ends of the costals the pits and ridges form a honeycomb arrangement, but on their outer fourths the ridges and pits are arranged in rows across the costals, toward their ends on some of the costals the honeycomb pattern again prevails, on others the rows persist to the smooth bevelled border.

In the form of the anterior end of the carapace, with slight emargination of the border at the sutural junction of the nuchal, and the close resemblance of the sculpture of the carapace, this specimen is in close agreement with the type of the species. The chief differences observed are the considerably larger size of the present specimen and the sloping bevel of the smooth ends of the costals, as contrasted with the abrupt bevel of the type.

A second specimen, C. M. No. 3255, in this collection consisting of many fragments of the neurals and costals is provisionally referred to this species. This specimen is from Horizon B, Uinta formation, and from the same locality as the individual previously discussed. It was collected by Dr. W. J. Holland, and Earl Douglass in 1908.

The type of *Amyda egregia* Hay is from the lower Washakie beds south of Hay-

stack Mountain, Wyoming, so that the discovery of the present specimens in the Uinta formation of Utah, considerably extends the geological as well as the geographical range of this species.

18. *Amyda scutumantiquum* (Cope).

Plate XXVI, fig. 2.

Trionyx scutumantiquum COPE, 6th Ann. Report U. S. Geol. Surv. Terr., 1872 (1873), p. 617; Amer. Naturalist, XVI, 1882, p. 988, fig. 6; Vert. Tert. Form. West., 1884, pp. 118, 121, Pl. XVI, figs. 1, 1a; Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

Amyda scutumantiquum HAY, Amer. Geologist, 35, 1905, p. 336; Fossil Turtles of North America, 1908, pp. 521, 522, plate 100, figs. 2-4, plate 101, fig. 1; text-figs. 676, 677.

A very large specimen C. M. No. 3272 (see plate XXVI, fig. 2), consisting of a considerable part of the anterior two-thirds of the carapace, is identified as pertaining to the above genus and species. This specimen was collected by Earl Douglass May 25, 1908, from the lower portion of Horizon B, "transition beds sandstone," Uinta formation, Upper Eocene, as exposed on the south branch of Red Bluff Wash, above the well on the stage-road between Bonanza and Kennedy's Hole, Uinta County, Utah.

This specimen lacks all of the carapace posterior to the fifth costals, the anterior border and left end of the nuchal, and small portions here and there of the costals forward of the sixth. The sandstone matrix containing the impressions of the seventh and eighth costals fortunately is preserved and serves to give a fairly accurate idea of the dimensions of the entire shell.

In form the carapace is broadly oval with the length slightly exceeding the breadth. The greatest width, as in the type, appears to have been at the middle. The extreme width is about 530 mm.; the length, at the very least, was 570 mm. The shell is broadly arched from the lateral borders to beyond the middle of the costal plates. Along the middle of the back there is a pronounced longitudinal depression which is deepest at about the middle of the shell.

The nuchal extends on each side of the midline about 180 mm.; its width on account of the missing anterior border cannot be given. At the center on the broken border the nuchal has a thickness of 23 mm. Its outer end is bevelled off toward the front and outer extremity. The length of the nuchal is .74 the width of the shell, whereas the type of the species is .76 (not .80 as stated by Hay).

The first neural is exceedingly large, being 93 mm. long and 50 mm. wide toward the front. The others present diminish in size posteriorly. The second, third, and fourth are coffin-shaped, with the widest end posterior, as is usual in the species of this genus. The principal dimensions of the neurals are given in the table.

No.	Length.	Width.
1.....	93.....	50
2.....	62.....	41
3.....	59.....	38
4.....	58.....	34

All of the costal plates except the first grow wider toward their outer ends. The expansion of the outer end of the second, as in the type, is especially pronounced. In the angulation of the free border of the second costal it resembles that of *Amyda salebrosa* Hay, more nearly than the type of the present species. At their free ends all of the costals preserved are bevelled off to a sharp edge, except at the point where the rib projects. None of the projecting ribs are preserved, so that the distance they extend beyond the free border cannot be determined. Near their outer ends at the sutural borders the costals have a thickness of from 5 to 9 mm. The width of the proximal and distal ends of the costals are given in the table.

No.	Width of Proximal End.	Width of Distal End.
1.....	91.....	62
2.....	58.....	103
3.....	63.....	79
4.....	58.....	79
5.....	59.....	84 _e

e, estimated.

The surface of the carapace is ornamented with the usual pits and ridges, there being two pits in a line 10 mm. long, and occasionally three. They are large and distinct, forming a honeycomb arrangement along the middle and on the proximal halves of the costal plates, becoming smaller and less deeply impressed toward the front. In small areas here and there at points about the middle of the costals the pits are arranged in rows across the short diameters of the plates. On the distal portions of the costals the pits are smaller and less deeply impressed, thus forming a very distinct pattern, and, as the smooth band is approached, the ridges show a tendency to break up into tubercles. Nowhere are the ridges wider than the pits.

Except for the considerably greater size of the specimen, and slight differences in the general distribution of the large and small pits the present individual agrees very closely with the type. The latter is from the Bridger beds on Cottonwood

Creek, in Wyoming, and the specimen here described is the first record of the occurrence of this species in the Uinta formation.

A second specimen, C. M. No. 3330, was collected by Earl Douglass in 1908, near the region of Well No. 2, Uinta Basin, Uinta County, Utah. It comes from the Uinta formation (horizon not given) and consists of fragments of costal plates having sculptured surfaces which are identical with those of the specimen discussed above, and is therefore regarded as pertaining to the present species.

Order **SQUAMATA.**

Suborder *SAURIA.*

Family *ANGUIDÆ.*

Genus *GLYPTOSAURUS* Auct.

19. *Glyptosaurus* sp. indet.

A specimen, C. M. No. 3405, consisting of the greater part of the parietal with other fragments of the skull and lower jaws, and a few shields, is identified as pertaining to the lizard-like reptile *Glyptosaurus*. It was collected by O. A. Peterson, August 24, 1912, on White River near Ouray, Uinta Basin, Utah, from Horizon C, Uinta formation, Upper Eocene.

The few osseous shields present are evidently from the trunk of the body. These are oblong quadrate, with a smooth, thinned out anterior end, which is overlapped by the next plate of the series. The lateral borders are roughened for sutural union. The external surface, excepting the smooth area mentioned above, is ornamented with small rounded tubercles closely arranged in more or less concentric rows. The cranial shields on the parietal are of irregular sizes with their surfaces ornamented much in the same manner as the trunk-shields.

This specimen may represent an undescribed species, but at the present time, on account of the very unsatisfactory type specimens upon which the nine described species have been based, it is impossible to make adequate comparisons, so that the specific determination of the present specimen must await the thorough revision of the species of the genus. It is of interest, however, as recording for the first time the occurrence of the genus *Glyptosaurus* in the Uinta formation, and also from the fact that it occurs intermediate geologically between the oldest known specimens from the Bridger described by Marsh, and the youngest specimen discovered and described by Douglass from the Oligocene.⁹

⁹ Douglass, Earl, "Some Oligocene Lizards," *Annals of the Carnegie Museum*, IV, 1908, pp. 278-283.

Nine species of the genus have been described from the deposits of North America. Geologically these are arranged as follows:

<i>Glyptosaurus montanus</i> Douglass.	Lower White River, Oligocene.
<i>Glyptosaurus</i> sp. <i>indet.</i>	Uinta formation, Upper Eocene.
<i>Glyptosaurus sylvestris</i> Marsh. <i>G. nodosus</i> Marsh. <i>G. ocellatus</i> Marsh. <i>G. princeps</i> Marsh. <i>G. brevidens</i> Marsh. <i>G. rugosus</i> Marsh. <i>G. sphenodon</i> Marsh. <i>G. anceps</i> Marsh.	Bridger, Eocene.

EXPLANATION OF PLATES.

PLATE XVIII.

- FIG. 1. Carapace of *Baëna arenosa* Leidy. C. M. No. 2356. One-half natural size.
FIG. 2. Plastron of *Baëna platyplastra*. Type. C. M. No. 3227. One-third natural size.

PLATE XIX.

- FIG. 1. Carapace of *Baëna inflata*. Type. C. M. No. 3406.
FIG. 2. Plastron of the same. Both figures one-third natural size.

PLATE XX.

- FIG. 1. Carapace of *Baëna gigantea*. Type. C. M. No. 3441.
FIG. 2. Plastron of the same. Both figures one-fourth natural size.

PLATE XXI.

- FIG. 1. Carapace of *Echmatemys callopyge* Hay. C. M. No. 2371.
FIG. 2. Plastron of the same. Both figures one-third natural size.

PLATE XXII.

- FIG. 1. Carapace of *Echmatemys douglassi*. Type. C. M. No. 3244.
FIG. 2. Plastron of the same. Both figures one-third natural size.

PLATE XXIII.

- FIG. 1. Carapace of *Echmatemys hollandi*. Type. C. M. No. 3249. Viewed from the right side. One-half natural size.
FIG. 2. Carapace of *Echmatemys depressa*. Type. C. M. No. 2936. Natural size.

PLATE XXIV.

- FIG. 1. Carapace of *Echmatemys obscura*. Type. C. M. No. 3252.
FIG. 2. Plastron of the same. Both figures one-third natural size.

PLATE XXV.

- FIG. 1. Plastron of *Hadrianus corsoni* (Leidy). C. M. No. 3403. One-fifth natural size.
FIG. 2. Plastron of *Hadrianus robustus*. Type. C. M. No. 3342. One-third natural size.

PLATE XXVI.

- FIG. 1. Plastron of *Hadrianus utahensis*. Type. C. M. No. 2343. One-fourth natural size.
FIG. 2. Carapace of *Amyda scutumantiquum* (Cope). C. M. No. 3272. One-fourth natural size.

PLATE XXVII.

- FIG. 1. Carapace of *Testudo uintensis*. Type. C. M. No. 2331.
FIG. 2. Plastron of the same. Both figures one-half natural size.